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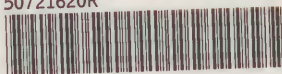
# DENTAL DRAWING

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## DENTAL DRAWING





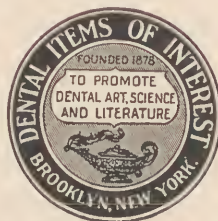
# DENTAL DRAWING

BY

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WITH ILLUSTRATIONS AND TWENTY-TWO FULL PAGE  
PLATES FROM ORIGINAL DRAWINGS BY THE AUTHOR



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## FOREWORD

THE object of this text is not to produce artists but to develop the student's or practitioner's ability for drawing, and by drawing tooth form to teach dental anatomy.

In the very earliest lessons to the youngest children, the alphabet is taught by writing the letters on the blackboard. This is the commencement of the study of free-hand drawing. As they learn to write the letters of the alphabet, they unconsciously draw them, for writing is, in fact, only drawing from memory. Drawing is the language of form, having but two letters in its alphabet, the straight line and the curved line. In this respect, our pictures will be like our own written words, made up of combinations of straight and curved lines, with this difference, that, while the word may suggest a name or a thought, the drawing suggests the thing itself. Both drawing and writing depend, for attainment, upon the faculty of imitation; though drawing, being simpler in its elements than writing, is more easily acquired. From this we can conclude that every person who has been taught to write may, therefore, be taught to draw.

EDWARD DROSEN, D.D.S.

June, 1924

Milwaukee, Wisc.



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# DENTAL DRAWING

## I

### THE BENEFITS DERIVED FROM A COURSE IN DENTAL DRAWING

DENTAL drawing is the art of representing the form, size, and arrangement of teeth and parts associated with the teeth on a plane surface, as on a sheet of paper.

In the course which this book outlines, the drawing of the teeth will prove of great assistance to you in determining the location of cusps, planes, ridges, grooves and surfaces of the teeth. The importance of root canal work is realized, and among the areas which you will be required to draw are the pulp cavities of all the teeth. This will familiarize you with the relationship of the pulp chamber to the dentine.

By drawing the teeth, you will gain knowledge as to their various forms and sizes, as well as instruction as to the number of roots which the teeth have. The plate, representing the occlusion of the teeth, shows you their anatomical arrangement and their relationship to one another, as far as their inclined planes are concerned.

It is also our object in this course, to study facial form and facial dimension, as well as harmony and symmetry of the mouth and face. In drawing the plates which deal with the evolution of the face, you will note the change of facial form that has taken place from infancy to senility. Note the falling inwards of both lips in old age; the loss of expression in the margins; the

formation of heavy lines at the corners of the mouth, and the general loss of vigor. A study of these things will be of benefit to you in your prosthetic work.

This treatise offers you a practical course in lettering, which you can adopt for general use and for other classwork in your curriculum where lettering is required. A study of shading is included. Shading is necessary to make the object stand out and to represent different surfaces and textures.

Dental drawing will increase your powers of observation and stimulate a taste for art and an appreciation of the beautiful. One does not need to be born an artist in order to make use of this teaching. Every product of constructive dentistry, operative or prosthetic, will give greater satisfaction to your patient and to yourself if fashioned in lines of beauty and harmony, in addition to utility. It is also of decided advantage, if to good taste, there be added such skill with brush and pencil, that the desired effect can be pictured to the patient in advance of production. Dental invention is greatly aided by skill in freehand drawing. The order of procedure is this:—First, the idea, then the freehand drawing; next the working drawing; next the pattern in wood and finally the completed article.

Dental drawing trains the hand to obey the mind. One cannot draw what one cannot conceive. Dental drawing makes the observation and memory much keener. It is easier to remember what we draw, because drawing impresses the facts upon the mind. Dentists become workers with their hands; hence dental drawing, which gives a knowledge of design, proportion and construction, is hand work and should be understood. It may also be stated, that most dental instruments are handled in the same manner as a pen or pencil, the pen grasp. This similarity brings to light another benefit, that of developing precision and accuracy in the use of dental instruments. Dental drawing will give you skill of hand in expressing ideas and concepts in visible form, so that others may see and comprehend. It will prove more effective

than the most elaborate print. Upon the completion of your course in dentistry, you will no doubt be called upon to give clinics and demonstrations in some field of dentistry, in which you may elect to specialize. As a clinician you will then realize the interest you can create during the evolution of your sketch. This interest has a high educational value, for the drawing and its associated facts are impressed upon the minds of the audience. How frequently will a few rapid lines aid in a description. In fact, the man who has become a master of drawing will find that, almost unconsciously, he uses his ability to draw to assist him in his oral descriptions.

## II

### HOW ART IS ASSOCIATED WITH DENTAL PROCEDURE

THE skill of an able dentist is a matter of artistry and craftsmanship. This artistic skill, as applied to dentistry, is in a great measure constructive or restorative. The dentist first conceives the construction or restoration mentally, in the idea, and then executes it by practical, artistic skill so as to duplicate Nature to the closest possible degree compatible with the individual environment and requirements. This is well illustrated in the construction of the full denture. The teeth are placed in the proper position so as to harmonize with facial and arch form. They are neither too light nor too dark, but graduate in color, as in a landscape. In a landscape, the artist portrays the colors of the foreground, darker and deeper than those in the distance. The darker colors of the foreground, diminish in tone in the distance and sky. In the teeth, the deep colors are found in the necks of the lower anterior incisors. The incisal halves of the upper central incisors are the lightest, and the tone becomes darker as it shades away into the lateral incisors and cuspids. This produces a spot of high light in an artistic manner.

The dentist shows his artistic ability by considering the color value of teeth, and by arranging the teeth slightly irregularly, and, if possible, so as to assume the positions formerly occupied by the patient's natural teeth.

We are confronted by similar problems in crown and bridgework. An artistic anterior bridge is one so constructed that very little metal shows. The pontics harmonize with the facial contour and complexion of the patient. Arch form must also be considered in the construction of an artistic bridge.

The porcelain jacket crown stands preëminently a restoration indicating the highest standards of artistic skill in dentistry. In many instances a transformation is effected, so surprisingly beautiful, that Nature is almost challenged. This crown can be used to correct such irregularities as protrusion, rotation, lingual malrelation, as well as every known tooth deformity. In a jacket crown, art relates to the reproduction of individual characteristics in form and color of the natural tooth.

Art has also progressed in operative dentistry. The gold inlay, anatomically carved and highly polished, is replacing the old, discolored amalgam filling. The result, while not perfect, is more pleasing and has a higher esthetic value than amalgam. The modern root canal technician exercises great care in his work, so as not to discolor the tooth, and if the tooth be discolored, steps are taken to decolorize the dentine to its natural shade.

The highest form of art, however, is wrought by the hands of the skilful orthodontist and oral surgeon. The unfortunate child, with irregular teeth and malformed face, which may be even repulsive, is at times transformed into an attractive or even beautiful being.

I cannot but recall at this time an interesting hare-lip case. The operation was completed save for the suturing of the vermilion tissue which was to form the child's future lips. At this stage of the operation, the oral surgeon, with the soul of an artist, used one of the fair nurses as his model, so that the lips might be properly formed and so that this child might take its place on this earth with no such handicap. I was fortunate enough to see this case after a lapse of several years, and I would challenge the average layman to detect this congenital deformity. Such efforts to create and restore, can only originate with one who appreciates art and the beautiful; one possessing a knowledge of the laws of harmony and symmetry.

Art is also associated with periodontia. Highly inflamed tissue, contaminated with pus, is regenerated into healthy pink, firm tissue. Teeth



are cleaned and ground in corrected occlusion, so as to overcome elongation and irregularities, thus restoring them to artistic harmony with their approximating neighbors. Such is the progress of art in dental procedures. Dentistry has progressed through the dentist's application of art to dentistry.

### III

## DRAWING INSTRUMENTS AND THEIR USE

### THE DRAWING BOARD

THE drawing board (Fig. 1) should be made of well seasoned straight-grained pine, the grain running lengthwise. To avoid the tendency of the

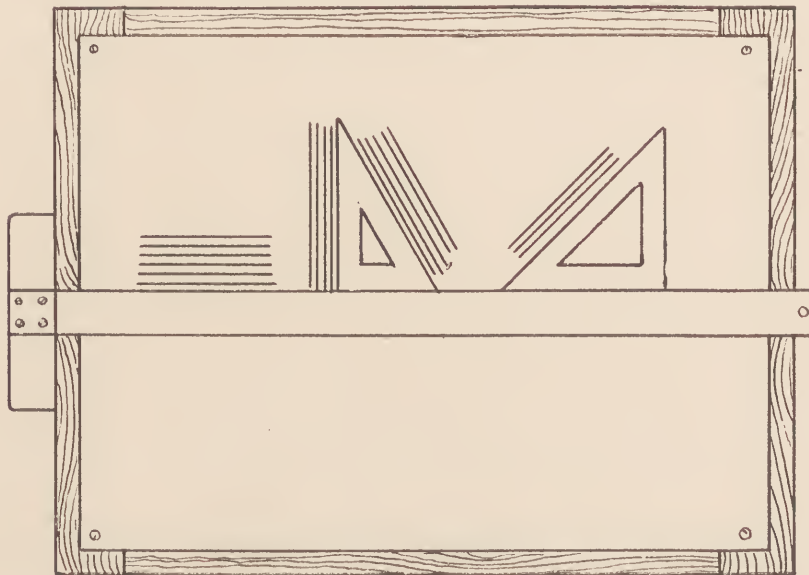


FIG. 1.

board to warp, the wood, of which it is made, is thoroughly dried before it is put together. But, as wood absorbs moisture from the air, warping will not be avoided if the board is kept near a stove, radiator, or other source of heat. The tendency to warp can be counteracted, to a considerable extent, by the manner of constructing the board.

Most boards are either veneered, or hardwood cleats are screwed to the back, to prevent the board from bending or warping.

The drawing board should be so arranged that the artist can do his work conveniently and to the best advantage.

### T SQUARE

The T square is used for the drawing of horizontal lines. The short cross-piece of the T square (see Fig. 1) is called the head, and the long piece

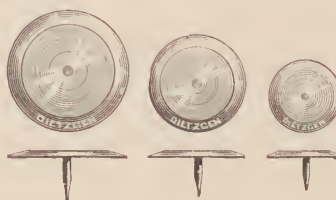


FIG. 2.

is called the blade. The head of the T square should be firmly held against the left edge of the drawing board when drawing horizontal lines. You observe that it is quite a simple matter to draw horizontal lines accurately and easily by the use of the T square by drawing your lines along the edge of the blade and running the T square upward or downward.

### DRAWING PAPER

The quality of drawing paper recommended for this series of lessons is smooth Strathmore, or Bristol board. These papers have a hard surface, and ink dries on them rapidly. Strathmore board has the advantage of withstanding erasures better than Bristol board. Either, however, will be found satisfactory.

### FASTENING THE DRAWING PAPER

The paper is fastened on the drawing board by means of thumb tacks (Fig. 2) which are small tacks, having large, flat heads. When fastening a sheet of drawing paper on the drawing board, lay the paper on the drawing



board with the edges parallel to and equally distant from the sides. Insert a thumb tack in the upper right-hand corner, about  $\frac{1}{4}$  inch from the edge of the paper, and press it in, until the head bears evenly on the paper all around. Line the upper edge of the paper so that it is parallel with the ruling edge of the T square blade. Then, by sliding the hand lightly and diagonally toward



FIG. 3A.



FIG. 3B.



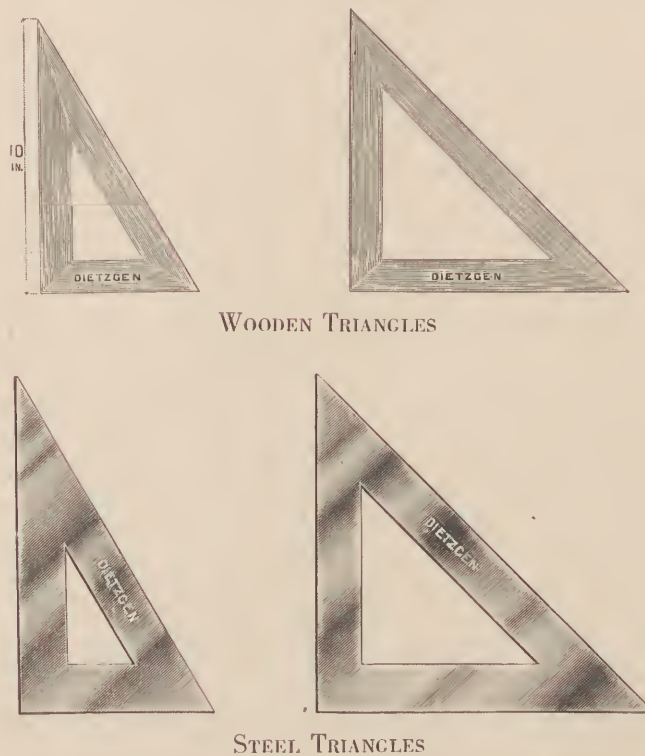
FIG. 4.

the lower left-hand corner and holding the paper there, press in another thumb tack, as before. Lay the left hand on the middle of the sheet, slide it very lightly towards the upper left-hand corner, and insert another tack. The fourth tack is inserted in the same way as the third, except that the left hand is slid from the center to the lower right-hand corner.

#### DRAWING PENCILS

For drawing lines and laying off dimensions, a 4-H pencil, of any good make, should be employed. Do not use a pencil softer than this for this kind of work, as the point of a soft pencil wears away so fast that accurate work cannot be done.

This pencil should be sharpened as shown in Fig. 3A. Cut the wood away so as to leave about  $\frac{1}{4}$  of an inch of lead projecting; then sharpen it flat by rubbing it against a fine file or a piece of fine emery cloth or sandpaper that has been fastened to a flat stick. Grind it to a sharp edge like a wedge (Fig. 3A), and round the corners very slightly, as shown in Figure 3B.



WOODEN TRIANGLES

STEEL TRIANGLES

FIG. 5.

For sketching in your layout a softer pencil is used. This pencil is sharpened to a point as shown in Fig 4.

### TRIANGLES

Triangles are used for drawing perpendicular lines, angles and parallel lines. The triangles most generally used are the 45 degree and 60 degree triangles, as shown in Fig. 5.

To draw a vertical line, place the T square in position to draw a horizontal line, and lay the triangle against it, so as to form a right angle. Hold both T square and triangle lightly with the left hand, so as to keep them from slipping, and draw the line with pen or pencil held in the right hand, and



FIG. 6.

against the edge of the triangle. Fig. 1 shows the triangles and T square in position.

#### COMPASSES

Compasses (Fig. 6) are used for drawing circles and for dividing lines into specified lengths. They are fitted with two arms which may be adjusted to meet various radii. One of these arms is fitted with a steel point which acts as a center, when a circle is drawn. The other arm has a socket, into

which may be fitted several extensions. One extension is used when drawing circles in pencil; one for drawing circles in ink; and the other, the steel point, is used for dividing a line, or a given space into parts. The compasses when used with this steel point are called dividers. Have leads sharpened flat and

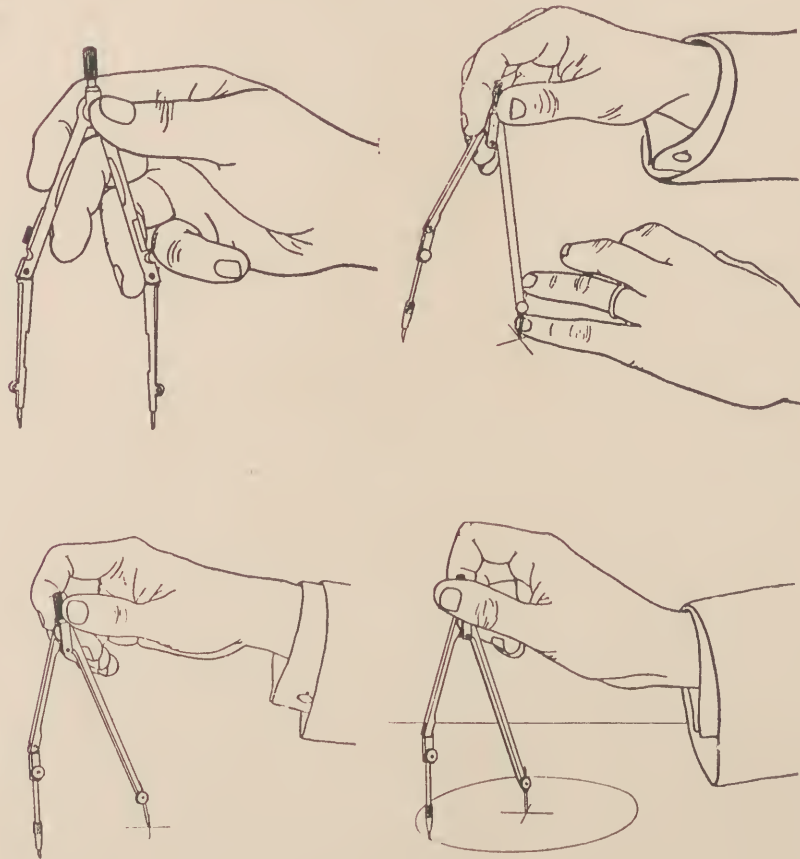


FIG. 7.

not to a point. Always sharpen the leads in this way, and insert them in the extension, so that the flat surface at the point of the lead will always face outward when a circle is being drawn. This insures a fine, clean line. Fig. 7 shows how the compass should be held for drawing circles.

## DRAWING INK AND RULING PEN

The ink recommended for drawing is waterproof, liquid, India ink (Fig. 8). A quill is attached to the cork of every bottle of this ink, by means of which the pen may be filled. The quill is dipped into the ink and



FIG. 8.

the end then passed between the blades of the drawing pen. No more ink than will fill the blades for a quarter of an inch, should be used; if too much is used, the ink is liable to drop and cause blots. The cork should be replaced in the bottle every time the pen is filled.

Before the drawing ink is used, the bottle should be well shaken, because some of the ingredients of the ink settle to the bottom and, if the ink is not well mixed, the lines will appear gray. If the ink becomes too thick, it may be diluted by adding a solution composed of one ounce of water and four drops of aqua ammonia, until the ink is of the proper consistency again. Pure water alone, should not be used to dilute the ink. India ink that



has been frozen cannot be used, as the lines will be very gray and indistinct. The ink bottle should always be kept tightly corked when it is not in use.

India ink dries quickly on a drawing, which is desirable; it also dries quickly on the blades of the pen, which is not desirable, because it prevents



FIG. 9.

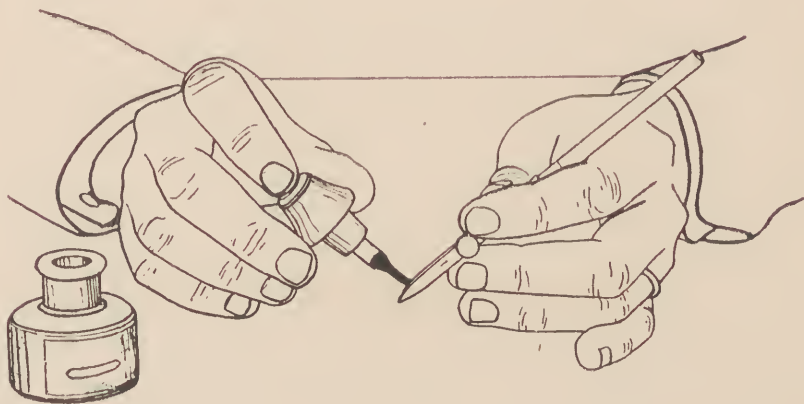


FIG. 10.

the ink from flowing freely, especially when the pen is adjusted for fine lines. The only remedy is to wipe between the blades frequently with a cloth. The blades should always be wiped out before the pen is laid down for any length of time. If the ink does not flow well, it may be started by moistening the end of the finger and touching it to the point, or by drawing a slip of paper between the points of the blades.

The ruling pen is used for drawing lines of various widths. This ruling pen is fitted with two blades (Fig. 9).

To fill the pen, dip the quill attached to the cork of your ink bottle and

insert between the blades of the ruling pen. No more ink should be placed in the pen than will extend from one-quarter to three-eighths of an inch upward from the point of the ruling pen (Fig. 10).

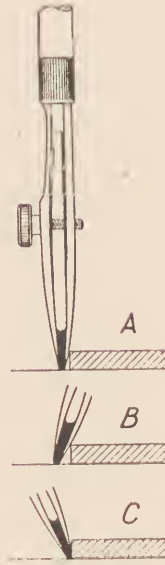
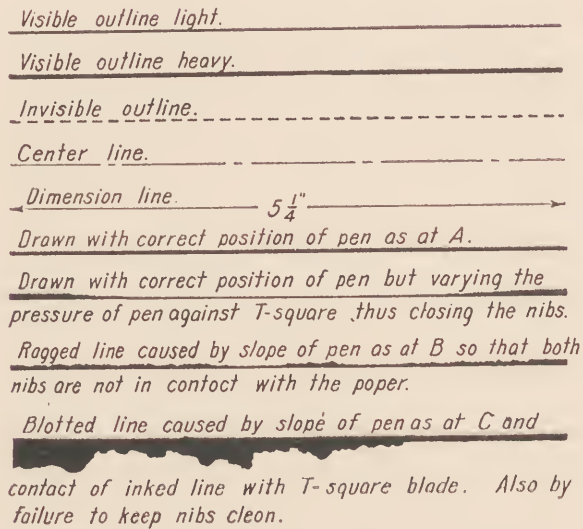


FIG. 11.

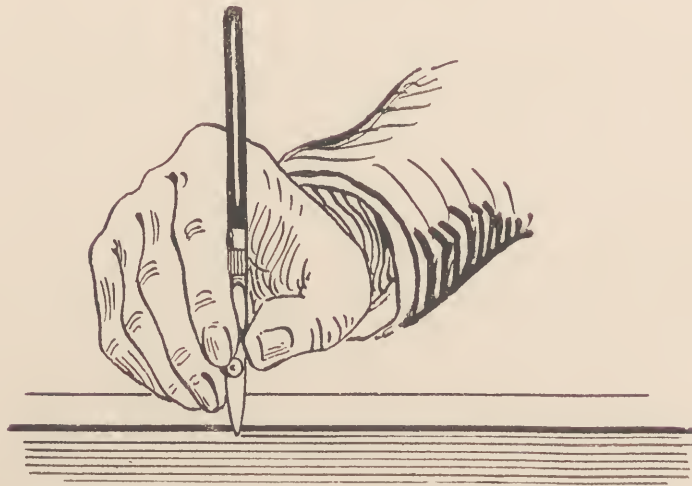


FIG. 12.

The edges of the T square, or triangle, are to be used only as a guide for a ruling pen. Both points of the blades of the pen must touch the paper. If they do not, your lines will be ragged (Fig. 11). Be sure that you hold

the pen perpendicular when using it (Fig. 12). Do not bear heavily on the pen, nor press it too hard against the edge of your rule, or guide. By regulating the set screw, which holds the two blades of the ruling pen together, and then drawing lines along the edges of the T square, the width, or thickness of these lines may be regulated.

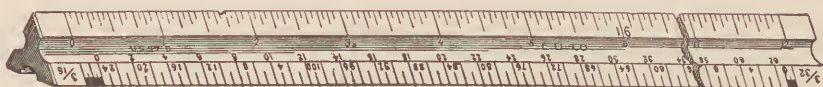


FIG. 13.

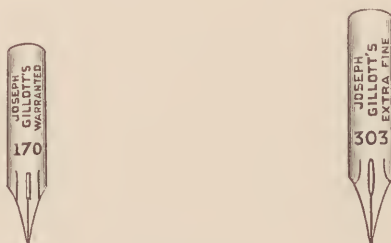


FIG. 14.



FIG. 15.

A little practice in drawing lines with this ruling pen will soon enable you to produce a great variety of effects, smoothly and easily.

### SCALES

Scales are used for laying off dimensions on drawings. The scales that are generally used, are triangular in shape, as shown in Fig. 13, or flat, with beveled edges. The edges of the triangular scale are graduated for different scales, but for our work the full-size scale is to be used. The full size scale is divided like the ordinary foot rule.



## DRAWING PENS AND HOLDER

For general purposes the best pens are probably Gillott's No. 170 and No. 303. They are fairly flexible when broken in and are not too sharp. For lettering use the Gillott's No. 303 pen. Gillott's No. 170 pen (Fig. 14) can be used for shading and general work. Fig. 15 shows a satisfactory holder.

#### IV

### CLEANING DRAWINGS

A DRAWING is almost sure to become soiled from the rubbing of your sleeves and from dust. This may be prevented to some extent by covering the work, except the part on which work is being done, with paper thoroughly



FIG. 16.



FIG. 17.

secured at the edges so as not to interfere with the operation of the triangles and T square. It is good practice, before commencing a drawing, to clean carefully the scales, triangles, and T square. The drawing board should be dusted before the drawing paper is tacked in place on it.

An inked drawing should not be erased until the ink has thoroughly dried.

All soiled spots and pencil lines can then be removed with an art-gum eraser (Fig. 16). This soft eraser will not injure the ink lines. In order to remove an inked-in line, or an ink blot, a hard eraser made of a mixture of rubber,



FIG. 18.

and emery or glass, should be used (Fig. 17). It is even sometimes necessary to use fine XX sandpaper to remove some ink blots. Do not use chemical ink eradicators, as they leave a yellow blotch on your paper. Fig. 18 shows a celluloid shield, with which it is possible to erase particular spots, without touching and thus injuring other parts of the drawing.

## V

### PRELIMINARY DIRECTIONS

#### THE DRAWING PAPER

THE size of the drawing paper to be used for the drawing work given in this course is  $8\frac{1}{2}$  x 11 inches Strathmore or Bristol board.

#### PENCIL SKETCH

The entire plate should first be penciled and the dimensions laid off accurately before any part is inked. Of course, the pencil work must not be so heavy that the ink will not take well to the surface of the paper. This pencil sketch, known as the "layout," is first submitted to your instructor for his approval before it is finally inked. Full directions for laying out each plate are given later in the text.

#### INKING

When your pencil sketch has been approved, you may proceed to ink in the work. Allow yourself plenty of room when inking. Your arm should be free and unobstructed in its movements. Nobody can ink well in a cramped position. When inking, do not try to make speed at first; speed will come with practice. Draw slowly to begin with, taking care that each line is black and that the edges are clean. Be sure that your ink flows freely and does not clog the pen. When inking your horizontal lines, you will find it well to draw them along the edge of a ruler or a straight edge, tilting it so that the edge which is nearest the line is raised about  $\frac{1}{4}$  of an inch above the paper. This

method may also be used when inking your vertical lines, by running the head of your T square along the bottom of your board, taking care that the edge of the blade is raised so as not to catch up ink and blot your paper. Solid spaces will, of course, need to be first outlined in ink, then filled in.

## VI

### LETTERING

EVERY student of dental drawing should have a thorough knowledge of lettering. You will learn how to make simple, clean lettering for practical purposes. The letters must be of uniform thickness and of the same style or "font," as it is technically called. We will employ for our work the unaccented letters, which are of two kinds, slanting and vertical; and the accented letters, slanting and vertical.

Unaccented letters are adapted for drawings having many parts that are to be labeled, or on drawings where the space of lettering is limited, as the letters of this form can be condensed, without materially affecting their legibility.

The slant style is the most natural, as the strokes approximate the direction of the strokes in ordinary writing. Accented letters are generally used for main titles and subtitles.

We will use the Gillott's No. 303 pen for lettering (Fig. 14).

It is possible to make more uniform lines with a pen after it has been used for a short time, than when it is new. Waterproof ink dries quickly and for this reason the point should be wiped frequently. A cloth free from lint, as the one enclosed with your waterproof India ink, should be used for this purpose, as the lint would get between the nibs of the pen and clog it.

#### SPACING OF LETTERS

By spacing is meant the placing of letters at such distances apart as to give the appearance of equal spacing between all letters. The shapes of letters vary, some having slanting sides, some straight sides, and some rounding sides; others have projecting stems, so that only



very general instructions can be given for spacing. Good judgment must be used for this. The letters of a word must be spaced so that the word will have an even appearance, and there will be no unduly large white space, or dark spot, at any point.

More space is required between two letters, both of which have straight sides, than between two letters, one of which has a straight side and one a round side. Less space is required between two letters with rounding sides, as OO or DO, than is required in either of the preceding examples. The space at the bottom between the two capital letters, AL, should be small so that the space between them at the top will be reduced to the minimum. The capital letters, AW, have parallel sides, consequently, considerable space is required between them. The letters that cause the most trouble in spacing are A, W, V, X, and Y. Unless good judgment is used, their slanting sides produce unequal white space. Letters with projecting strokes as F, J, L, and T, are difficult, at times, to combine with other letters. The letters that are most easily spaced are those with straight sides as H, B, N, D, etc.

#### UNACCENTED SLANTING LETTERING

This form of lettering is shown on Plate 1. The direction of the strokes is indicated by small arrows and the order in which they are made is shown by numerals. To produce well-formed and neat appearing letters, the direction and order of the strokes, as given, should be observed.

Three elements enter into the construction of the form of letters. These are the straight line, the loop, and the hook, as shown on Plate 1, upper line; or modifications of the loop and hook, as will be seen by referring to Plate 1, second line. The loop is the main

element in the letters a, b, d, g, p, and q, and modifications of it enter into the construction of the letters c, e, and o. In the letters a, d, g, and q, the point of the loop is at the top, and in the letters b and p the point of the loop is reversed. The hook, with the turn at the top, is used in forming h, m, and n, and the reversed hook is used in u. The only difficulty that will be experienced in making the letters v, x, and y, both lower case and capitals, is to draw the sides of the letters at the proper angle. These letters will be well formed if the sides of v, and of the v part of the x and y, are drawn so that the upper extremities are equally distant from an assumed center line at the angle to which the letters are made, as shown on Plate 1, second line. Until the student becomes proficient in drawing the lines of letters at a uniform slant, a templet of the slant used in the illustrations may be used for drawing guide lines. It may be of either cardboard or wood. The angle, or slant, for the templet may be found by stepping off on a vertical line of any length, points to divide it into eight equal parts, and then stepping off three of these equal divisions on a horizontal line. A line drawn through the extremities of the vertical and horizontal lines will give the hypotenuse of a triangle of the correct angle or slant, and this angle may be laid off on a templet of any size. In practising the drawing of letters, care should be taken to have the slant and curved lines of all letters extended fully to the guide lines, and the letters should be of proportional width. If these instructions are not carefully followed, the letters will present an uneven appearance. Care should be taken to have the ascending stems of letters as b, d, f, etc., extend fully to the upper guide line; the descending stems of letters as f, g, j, etc., should extend the same distance below the base guide line that the ascending stems extend above the guide line for the height of the lower case letters.



O O N U

adgq bp ceo hmn xz vy ijfl

d b e m x y f ~ X Y

A B C D E F G H I J K L M N

O P Q R S T U V W X Y Z &

a b c d e f g h i j k l m n o

p q r s t u v w x y z

1 2 3 4 5 6 7 8 9 0

PLATE I

Edward J. Drosen

The rounded letters, as c, e, and o, are usually the most difficult to make, and close attention should be given to their construction. The loops and curves of letters should be practised until the hand becomes so accustomed to the movements that they can be made with ease and facility.

#### UNACCENTED VERTICAL LETTERING

The unaccented, vertical letter, Plate 2, is a good form letter, but the beginner will find it harder to make the strokes uniform than in the case of slanting letters, which are also more easily condensed. The formation of the vertical style of letters is shown on Plate 2, which also shows the order and direction of the strokes. The forms should be carefully studied and the order and direction of strokes followed. The rules given for the spacing of slanting letters will apply to the spacing of the vertical style.

#### ACCENTED SLANTING LETTERING

This is the style of lettering shown on Plate 3B. It will be used for the main titles on subsequent drawing work. The slant of the lettering is 60 degrees and is made with a triangle. The rules given for spacing the unaccented letters apply to this alphabet. Care must be taken to have the letters the same thickness throughout.

#### ACCENTED VERTICAL LETTERING

Another type of lettering, shown on Plate 3A, is also used for large headings, or titles of the plates. The width of the spaces between the letters depends on the combination of the letters in words; the best plan to follow in this alphabet is to compare the spacing between the various letters as shown in the illustration. Note the space

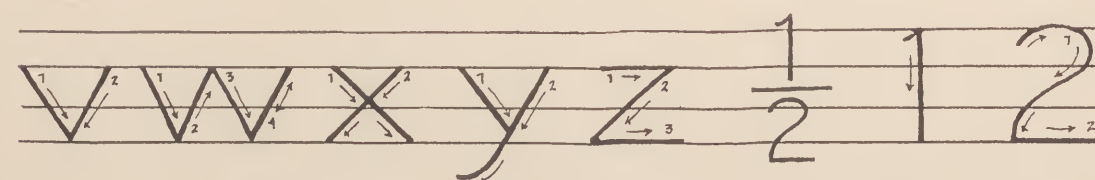
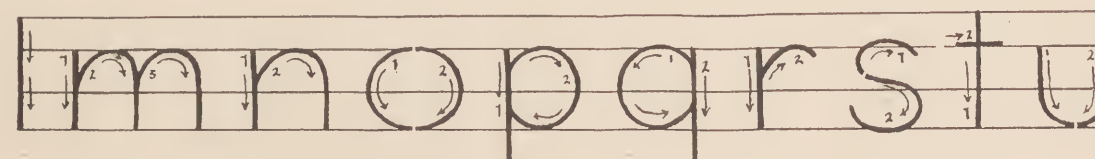
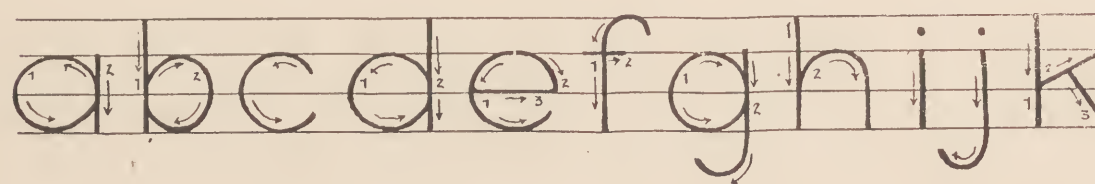
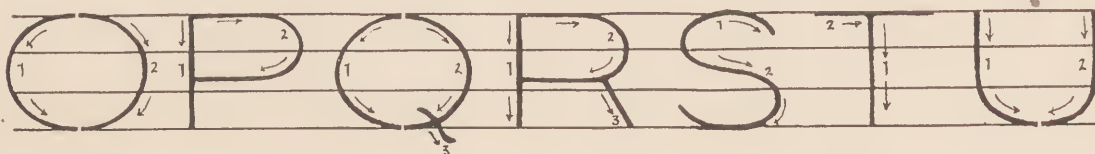
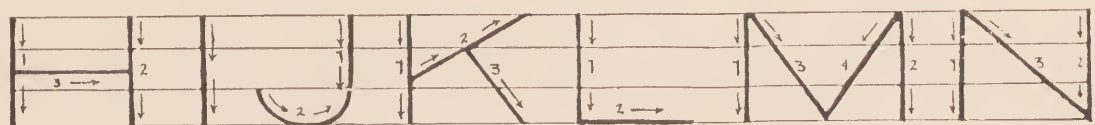
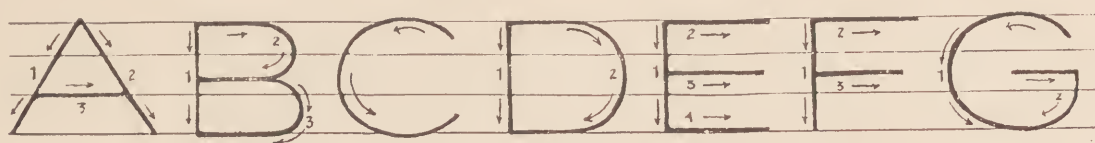


PLATE 2

between the letters A and B and compare it with that of B and C, and follow this plan throughout.

After studying over carefully the relative forms of the letters, draw these exercises, same size as the charts. You may use your dividers for measuring and spacing. When drawing the plates, it will not be necessary to draw the small, direction, stroke arrows, or stroke numerals. Guide lines, however, are to appear on your drawings in pencil, and may be erased after the drawing is completely inked and dried. Use your T square and triangle as instructed, and your mechanical instruments where necessary. Note how your name is to appear on these plates and thereafter. Take measurements from Plate 1 as to the height of the name in writing, and distance from border lines. Underscore as indicated on Plate 1.

#### EXERCISES TO BE SUBMITTED

- Exercise 1. Draw Plate 1 the same size as the chart.
- Exercise 2. Draw Plate 2 the same size as the chart.
- Exercise 3. Draw Plate 3A and 3B the same size as the chart.
- Exercise 4. Draw in panel form the following wording, using the type of lettering you think is indicated. Have a border line around the drawing with your name in the lower right-hand corner. "Dental drawing is the art of representing the form, size, and arrangement of teeth and parts associated with the teeth on a plane surface, as on a sheet of paper."



ABCDEFGHIJKLMNOPQRSTUVWXYZ  
1234567890

PLATE 3A

*ABCDEFGHIJKLMNOPQRSTUVWXYZ  
1234567890*

PLATE 3B

## VII

### SHADING

#### SHADING

Shading is the use of lines, dots and solid blacks to give color to a sketch. The term "color" is used here, not in the ordinary way, but as applied to pen and ink work. When an object is drawn in outline form it appears flat. Shading is necessary to make the object stand out. Shading applies to the use of blacks, dots and lines as described. Shadows are caused by light striking an object, the result being a shadow on one side of the object opposite to the source of light. We will take up the study of shadows later.

There is a great opportunity for originality in the handling of pen lines, but no matter what style of pen handling you finally adopt, there are certain principles that must be considered. To represent different surfaces and textures, different handling of lines is necessary. In other words, the different handling of lines is adopted for the character of different surfaces. No matter how individual your style may be, you must modify it to suit the character of each different object in your picture. On Plate 4 I have shown distinct styles of pen handling, and these are all you will ever need for representing a surface, or texture. Your individual style may tend towards one, but you will be obliged to depend upon one of the others, as the work may require.

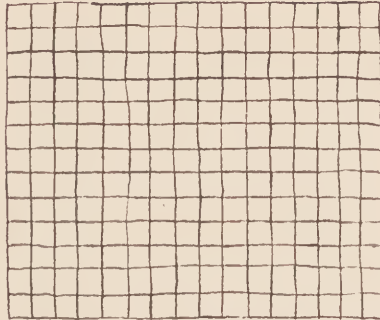
We will first take up *cross-hatching* (Plate 4, sections 1, 2, 3, and 4). It has been used as a general style by some very great artists.

# SHADING

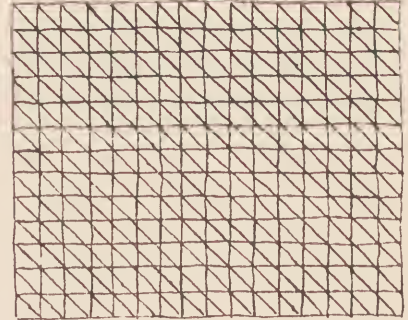
1.



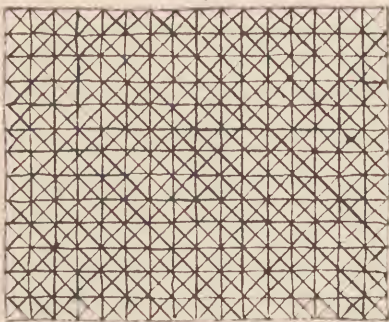
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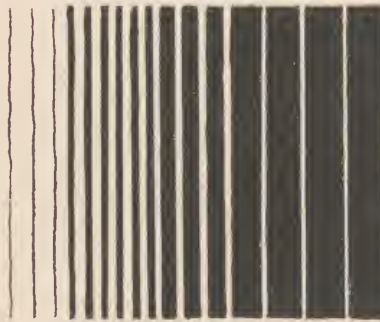
3.



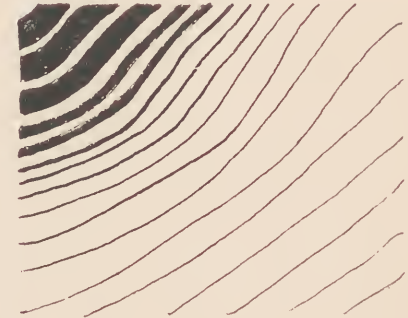
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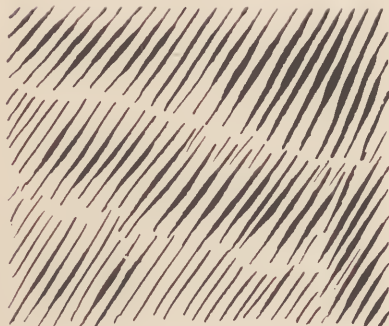
5.



6.



7.



8.



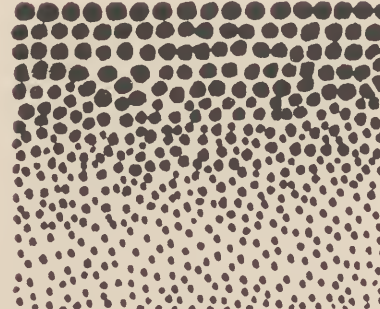
9.



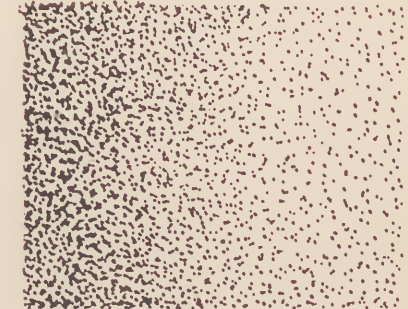
10.



11.



12.



## PLATE 4



However, its reproduction qualities are not so good as lines drawn parallel to one another. The principle of shading, with cross-hatch, is that each time you add a line at a different angle, you make the tone darker. Our drawing (Plate 4, sections 1, 2, 3, and 4) illustrates this principle; we first started with vertical lines then crossed them with horizontal lines, then diagonally in one direction, and finally diagonally in the other direction, obtaining a darker tone with each added series of lines.

In the *even line shading* (Plate 4, sections 5 and 6) the darker or wider the lines are, the less should be the amount of space between them; and the darker the tone to be represented, the heavier should be the line. This style, in its pure state, is very good for mechanical subjects.

In the *shaded line style* (Plate 4, section 7), the style we will use principally, we have a more flexible handling; more pressure is applied to the pen in the center of the line than at the ends, according to the surface being represented. However, in making any series of short pen lines, it is best to start the line lightly and end it very lightly. By lifting the pen quickly at the end of the line you are less likely to leave a dot, or ragged end.

The *varying line style* (Plate 4, sections 8 and 9) is a series of lines made in different directions, which gives considerable freedom where it is necessary.

You can see that the light and heavy line principle, of the even line shading, may be used in combination with cross-hatching, as also may the shaded lines and the varying lines styles of shading. In making very wide lines, remember, it is not necessary to make them with a single stroke of the pen. You may work over your lines until you get the required thickness.

Another form of shading is by producing a mass of dots. This is called *stipple work*. Plate 4, section 10, shows an even tint made by small dots placed at approximately even distances apart. These are light, as very little pressure was applied to the pen in making them. Section 11 shows a tint of larger dots; in this case considerable pressure was applied to the pen in making them and an effort made to make the dots nearly round. Stipple drawings may be shaded either by making the dots larger in the darker portions, or by making dots of uniform size close together; a combination of the two may also be used.

Section 12 shows a stipple shading made by starting the tint with dots of nearly equal size. In this style of shading, the pen is handled quite rapidly, in a hit or miss manner. First, lay a moderately even tint of dots; then, to darken it, fill in with other dots placed between them, according to the strength of shading necessary. In doing this the additional dots will join the first dots and the shading becomes darker.

#### DRAWINGS TO BE SUBMITTED

Exercise 1. Make a complete copy the same size of all examples on Plate 4.

## VIII

### SHADOWS

LIGHT and shadow in nature are represented in a drawing by light and dark tones, thereby giving a solid appearance to objects, and an impression of reality. Nature has no means of distinguishing solid objects, other than by light and shade, without which it would be impossible to distinguish their form.

Objects are viewed under various conditions of light, such as sunlight, daylight, and artificial light, and the effect varies in accord with each condition in which they are seen. As a general rule, you will find that the brighter the light is, the stronger and more sharply defined will be the shadows. The shadows are sharp in bright sunlight; less distinct in ordinary daylight; and are scarcely visible on dull days.

When a single light is thrown on an object, it illuminates one part only. The space on an object, situated directly opposite that which is lighted, is called the "shadow," and the space on the ground occupied by the shadows cast by the object is called the "cast shadow." The forms of all objects are developed by means of light and shade; without these they would appear flat.

When objects of different color values are exposed to the same light, the white objects will appear lighter in tone than the colored ones. A similar relation will be found between white and colored objects in shadow, but somewhat modified, of course, by reflected light. The cast shadow of an object, when cast on a surface of the same color as the object, is always darker than the shadow on the object. All shadows are modified by the reflection of light from surrounding objects. The edges of shadows are strongest in color, when near the eye, and decrease in strength and intensity as they recede from it.

To illustrate a method of shadow shading, the light being received from the left side, the first thing to be determined is, which portion of the object is in light and which portion in shadow? The part of the model receiving direct light, is in the light, and the part affected only by reflected light, is in the shadow. The extreme lightest portion of the lighted area is called the "high light." Any part other than the shadow will be lighter than any of the shadow. The principles to remember are that all forms are developed by means of light and shade; that every opaque object has one part upon which the light falls directly and one part upon which the light is received only by reflection.

## IX

### THE TEETH

THE remainder of the subjects which you will be required to draw, deal directly with the teeth.

The teeth are arranged in curving arches, and are hard calcified substances, connected with the jaw-bones by means of the alveolar processes. They have for their function, the mastication of food and also help in the production of speech.

There are two sets of teeth. The first set is known as the deciduous set and are twenty in number. The cutting of the deciduous teeth begins between the fifth month and the eighth month after birth and terminates between the twenty-fourth and thirty-second months. The following teeth constitute the deciduous set: Central incisors, lateral incisors, cuspids, first molars and second molars.

After the completion of first dentition, at about the age of three years, there is a period of rest established, before the appearance of the second, or permanent teeth. During this period of rest, the jaws are developing, as are the roots of the deciduous or baby teeth. The roots of the deciduous teeth are completely developed three years after their eruption.

Second dentition begins at about the sixth year and when completed there are thirty-two permanent teeth.

The following comprise the list of permanent teeth: Central incisors, lateral incisors, cuspids, first bicuspid, second bicuspid, first molars, second molars, and third molars.

A comparison of the list of permanent teeth with that of the deciduous teeth will reveal that there are no bicuspid in the deciduous set. The decidu-



ous molars are replaced by the bicuspid, the permanent molars erupting distally of the deciduous set.

A tooth is divided into two principal parts, the crown and the root. *The crown* is that portion of a tooth that is above the gum. *The root* is embedded in the alveolar process of the jaw-bone. The crown is covered with enamel, while the root is covered with cementum which slightly overlaps the enamel at the gum margin. The dentine composes the greatest bulk of the tooth and extends through the crown and root. In the center of the dentine, extending through the crown and root, is the pulp cavity. The pulp lies in the pulp cavity. It is composed of arterial and venous blood vessels, nerves, lymphatics and cells. The blood vessels, nerves and lymphatics pass through an opening known as the "apical foramen." A fibrous membrane known as the "peridental membrane" acts as a cushion and separates the roots from the bony wall. The teeth are supported by a bony structure known as the "alveolar process." A fibrous connective tissue known as the "gum," covers the alveolar process.

#### TOOTH SURFACES

The teeth present the following surfaces for examination:

*The Occlusal Surface* is that portion of a tooth used in masticating and occurs on bicuspid and molars.

*The Mesial Surface* is that portion of a tooth which is nearest to the median line.

*The Distal Surface* is that portion of a tooth which is farthest away from the median line.

*The Labial Surface* is that portion of a tooth which faces the lips, as the incisors and cuspids.

*The Buccal Surface* is that portion of a tooth which faces the bucca, or cheek, as on the bicuspid and molars.



*The Lingual Surface* is that portion of a tooth which faces the lingua, or tongue.

*The Proximal Surface* is that portion of a tooth which touches its neighbor. The proximal surfaces are therefore the mesial and distal surfaces. The point at which the teeth approximate is called the *contact point*.

*The Incisal Surface, or Incisal Edge* is that portion of a tooth which antagonizes with the surface of the opposing teeth during the process of incision. The gingival margin, neck or cervix, is that part of the tooth where the enamel and cementum meet.

The occlusal surface presents for examination: cusps, ridges, fossæ, sulci and grooves. Fissures are faults or crevices, caused by the non-coalescence of enamel plates during the developmental period.

We will next take up the description of the various teeth.

---

### Upper Central Incisor

Plates 5, 12, & 13

This is the largest of the incisor teeth, and the most conspicuous tooth in the mouth. It is the first one of the upper permanent incisors to erupt.

#### CROWN PORTION

The crown of the tooth is wedge-shaped with the sharp edge pointing downward, in the maxillary incisors and upward in the mandibular.

#### LABIAL SURFACE

The labial surface, shown on Plate 12, is convex and shaped like an irregular quadrilateral. The labial surface is marked by two grooves running vertically which are known as developmental grooves.

#### LINGUAL SURFACE

The lingual surface, shown on Plate 13, is convex at the gingiva and the remainder of the surface is concave. The center of the tooth

UPPER CENTRAL INCISOR



LOWER CENTRAL INCISOR



PLATE 5

presents a concavity known as the lingual fossa. This fossa is bounded mesially and distally by marginal ridges.

#### MESIAL AND DISTAL SURFACES

The mesial and distal surfaces are generally convex, and resemble a triangle with its base at the gingiva, and the apex at the incisal edge.

#### INCISAL SURFACE, OR INCISAL EDGE

The incisal edge is nearly straight horizontally and at right angles to the crown. In newly erupted teeth, the edge presents three little tubercles, which separate the developmental grooves. In old age, the incisal edge becomes worn and may expose the dentine.

#### ROOT

The root (Plate 5) is nearly straight and is cone shaped. The apex may be slightly curved.

#### PULP CAVITY

Plate 5 shows several outline drawings of the pulp cavities of the upper and lower centrals. The first drawing, in the upper, left-hand corner, presents the mesio-distal section of the upper central incisor. The upper middle drawing is a cross-section of the pulp cavity of the same tooth. The upper right-hand corner presents a labio-lingual section. It can be seen from the drawings, that the pulp cavity follows in general form, the outline of the tooth.

---

#### Lower Central Incisor

Plates 5, 12, & 13

The lower central incisor is the smallest tooth in the dental arch. Restorations are not easily made for this tooth, due to the narrowness of the

space between the enamel and the pulp cavity which renders it very difficult to secure the proper retention.

#### CROWN PORTION

The crown is also wedge-shaped and presents four surfaces for examination and study; the labial, lingual, mesial, and distal surfaces.

#### LABIAL SURFACE

The labial surface (Plate 12) is nearly rectangular in shape, the mesial, distal and incisal outlines being straight while the gingival outline is curved downward. This surface is convex and also marked by two developmental grooves.

#### LINGUAL SURFACE

The outline of the lingual surface (Plate 13) is the same as the labial surface. This surface presents three marginal ridges; one on the mesial, on the distal and at the gingiva. These three ridges form a well developed V shaped ridge.

#### MESIAL AND DISTAL SURFACE

Both surfaces are convex and are triangular in shape (Plate 5).

#### INCISAL SURFACE OR INCISAL EDGE

The incisal edge is of varying thickness, and more or less at a right angle to the crown.

#### ROOT

The root is very narrow mesio-distally (Plate 5), but generally straight. There may be a groove formed on the mesial or on the distal surfaces.

#### PULP CAVITY

The pulp cavity (Plate 5) follows roughly the outline of the tooth. The lower, left-hand corner drawing on Plate 5, shows a mesio-distal section. The lower middle drawing shows a cross-section and the

lower right-hand corner shows a labio-lingual section. If great care is not used, perforations may result when using burs in this pulp cavity.

#### PROBLEM

1. Make a copy of Plate 5 and label the sections shown. This lettering should be  $\frac{1}{8}$  inch high, using unaccented vertical or slant lettering. Lettering should appear underneath and in the center of the views shown.

---

#### Upper Lateral Incisor

Plates 6, 12, & 13

This tooth approximates on the mesial side with the upper central incisor and on the distal, with the upper cuspid.

#### CROWN PORTION

The distal surface of this crown is very convex, making the contact point very prominent on the distal surface.

#### LABIAL SURFACE

The labial surface (Plate 12) is convex and its shape is an irregular quadrilateral. This surface is marked by developmental grooves. The mesial outline is longer than the distal on this surface.

#### LINGUAL SURFACE

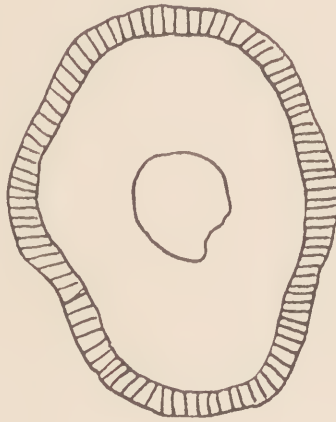
On the lingual surface (Plate 13) the marginal ridges appear stronger and heavier than those of the upper central incisor. This surface is slightly wider than the labial. It has a depression known as the lingual fossa.

#### MESIAL AND DISTAL SURFACES

The mesial and distal surfaces have the same characteristics as the incisors, but the mesial surface is longer than the distal from the incisal edge to the gingival ridge.



# UPPER LATERAL INCISOR



# LOWER LATERAL INCISOR

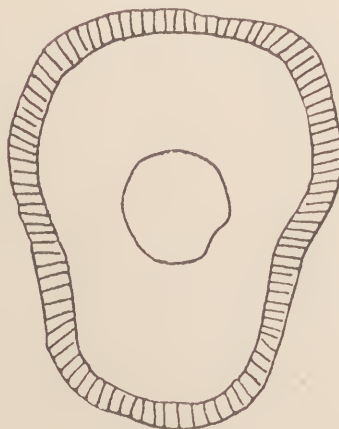


PLATE 6



## INCISAL SURFACE OR INCISAL EDGE

The mesio-incisal angle is quite sharp, while the disto-incisal angle is rounded. The distal surface of this crown being very convex and the contact point prominent, the incisal edge, instead of being straight is oblique.

## ROOT

The root (Plate 6) is of the same form and shape as it is in the central incisor, although the root of the upper lateral incisor has a tendency to be curved. The root may also be shorter than the central incisor root.

## PULP CAVITY

The pulp cavity has the same outline as the tooth. Plate 6 shows the same arrangement of views of the lateral incisor, as those of the central incisor on Plate 5.

---

Lower Lateral Incisor

Plates 6, 12, & 13

This tooth approximates on the mesial side with the lower central incisor and on the distal with the lower cuspid.

## CROWN PORTION

The crown is larger than that of the lower central incisor but it has the same shape.

## LABIAL SURFACE

The labial surface is convex in all directions (Plate 12). The labial surface is also marked by developmental grooves. It is wider towards the incisal edge, mesio-distally, than the lower central incisor.

## LINGUAL SURFACE

On the lingual surface (Plate 13) there is a concavity in the central portion, formed by the marginal ridges. It is convex in all other directions.

## MESIAL AND DISTAL SURFACES

The mesial and distal surfaces are similar to those of the lower central incisor.

## INCISAL SURFACE, OR INCISAL EDGE

The incisal edge is similar to that of the lower central incisor.

## ROOT

The root (Plate 6) may be flattened on the mesial and distal surfaces. It is wider labio-lingually than it is mesio-distally.

## PULP CAVITY

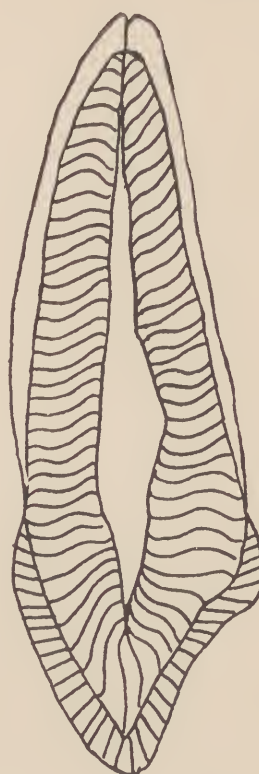
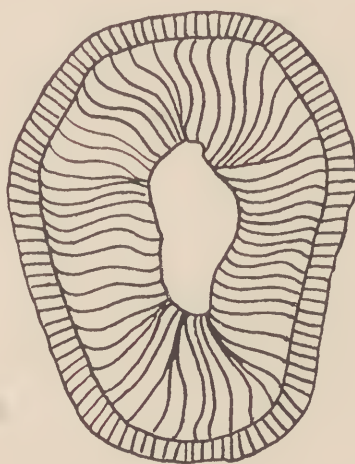
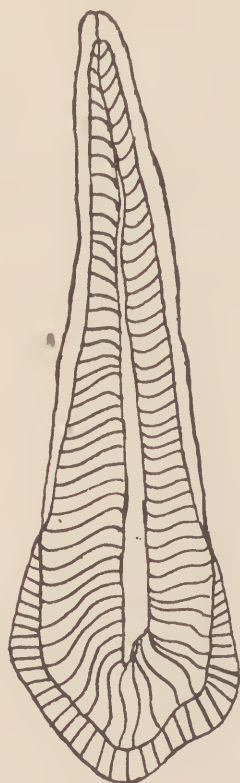
The pulp cavity (Plate 6) is larger than in the lower central incisor but follows the outline of tooth in same manner as in the lower central incisor. Arrangements of sections are the same as in Plate 5.

Plate 6 also shows the enamel rods. It will be noticed that these rods radiate from the body of the dentine perpendicularly to the surface of the crown. The rods are united by a transparent cement substance.

## PROBLEM

1. Make a copy of Plate 6 and label sections shown. For lettering directions see Problem—Plate 5.

# UPPER CUSPID



# LOWER CUSPID

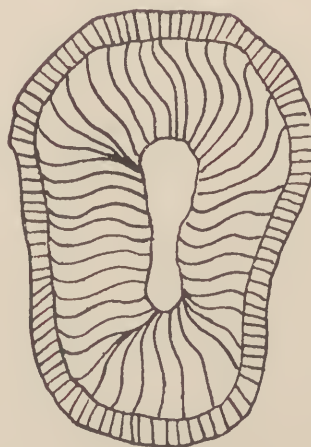
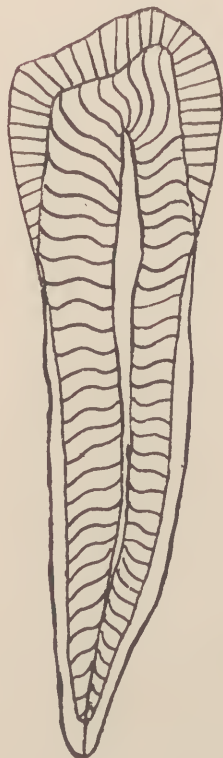


PLATE 7

## Upper Cuspid

Plates 7, 12, &amp; 13

The upper cuspid approximates with upper lateral incisor and upper first bicuspid. The shape of the incisal edge determines the name. The cuspid forms the corner of the mouth and is quite prominent.

## CROWN PORTION

The crown presents a central lobe, which is larger than the mesial, or distal lobes. This lobe forms the cusp of this tooth.

## LABIAL SURFACE

The labial surface (Plate 12) is greatly convex due to the development of the central lobe, which forms the labial ridge. This ridge forms two sloping borders, the mesio-incisal border and the disto-incisal border. In all, this surface presents five borders: two approximal, two incisal, and one cervical.

## LINGUAL SURFACE

The lingual surface (Plate 13) at the gingiva is much narrower than the labial surface. The linguo-gingival ridge which runs through the center of the tooth is found on this surface. At the gingiva, this ridge is marked by a tubercle.

## MESIAL AND DISTAL SURFACES

The mesial and distal surfaces are convex and triangular in shape. The base of the triangle at the gingiva, on both the mesial and distal surfaces, is of greater dimension labio-lingually than in the incisors.

## INCISAL SURFACE, OR INCISAL EDGE

The mesio-incisal angle is shorter than the disto-incisal angle. These two angular planes meet to form the cusp. This angular surface may become worn and shortened in old age.

**Root**

The upper cuspid has the longest root of any tooth in the mouth. This root is conical in shape and may be bent distally, at the apex.

**PULP CAVITY**

The pulp cavity follows the outline of the tooth and is quite large. Plate 7 shows the different sections.

---

**Lower Cuspid**

Plates 7, 12, & 13

The lower cuspid approximates with the lower lateral incisor and the lower first bicuspid. It is more delicate in shape and slightly longer than the upper. It approximates with the lower lateral incisor on the mesial surface, and with the lower first bicuspid on the distal surface.

**CROWN PORTION**

The crown is slightly longer than that of the upper cuspid, but follows the general outline of the upper cuspid.

**LABIAL SURFACE**

The labial surface (Plate 12) is decidedly convex towards the first bicuspid. It has five borders, and in general resembles the labial surface of the upper cuspid.

**LINGUAL SURFACE**

On the lingual surface (Plate 13) the ridges are not so well developed, as are the ridges of the upper cuspid. The surface is smoother and the absence of the lingual tubercle is noticeable.

**MESIAL AND DISTAL SURFACES**

The mesial and distal surfaces are convex, the distal surface being more convex than the mesial.



## INCISAL SURFACE, OR INCISAL EDGE

The incisal edge is formed by the mesial and distal planes, as in the upper cuspid.

## ROOT

The root (Plate 7) is shorter and more flattened on the mesial and distal surfaces than the upper cuspid.

## PULP CAVITY

The pulp cavity (Plate 7) follows the general outline of the tooth. Plate 7 shows the different sections of this tooth. Besides showing the enamel rods, the dentine and dentinal tubules are also indicated. These tubules permeate the entire bulk of the dentine. Their direction is wavy and curved. These tubules contain the dentinal fibrils, which have their origin in the pulp.

## PROBLEM

1. Make a copy of Plate 7 and label sections as before. Be careful to represent the enamel rods and dentinal tubules in the direction which they assume, as Plate 7 shows.



## Upper First Bicuspid

Plates 8, 12, 13, &amp; 14

The upper first bicuspid approximates with the upper cuspid on the mesial side and with the upper second bicuspid on the distal. The upper first bicuspid is the largest of the bicuspid. The name bicuspid is a misnomer, because only the upper bicuspid have two cusps; the lower bicuspid may have from one to three cusps. The bicuspid present an additional surface for examination, the occlusal surface. This surface will be discussed in detail later. The four other surfaces presented for study are the buccal, lingual, mesial and distal surfaces.

## CROWN PORTION

The crown is irregular cuboidal in shape and the occlusal surface is considerably wider than it is at the gingival.

## BUCCAL SURFACE

The buccal surface (Plate 12) resembles the labial surface of the upper cuspid, except that the crest of the cusp of the first bicuspid is nearer to the center of the buccal surface, thus dividing the mesial and distal incisal planes more equally, the mesial being slightly shorter than the distal.

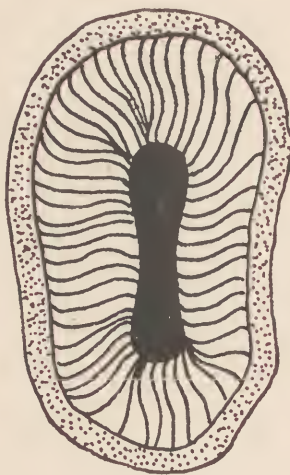
## LINGUAL SURFACE

The lingual surface (Plate 13) presents the same characteristics as the buccal except that the lingual cusp is more round than the buccal cusp and the surface in its entirety is smaller than the buccal surface.

## MESIAL AND DISTAL SURFACES

The mesial and distal surfaces (Plate 8) are convex, the distal surface presenting a greater convexity than the mesial surface; consequently, the distal surface is wider. The buccal triangular ridge meets the

## UPPER FIRST BICUSPID



## LOWER FIRST BICUSPID

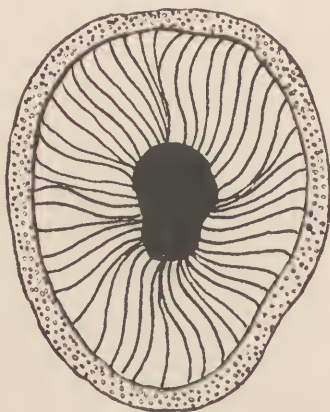


PLATE 8

lingual triangular ridge at the central fossa, to form a "V" shaped division between the buccal and lingual cusps.

#### OCCLUSAL SURFACE

In outline form the occlusal surface (Plate 14) is an irregular quadrilateral. Of the two cusps on this surface, the buccal cusp is the largest. A central groove, or the central fossa, as it is sometimes called, divides these two cusps. This central groove runs mesio-distally and, as it approaches the mesial surface, it divides to form two grooves which in turn form a "V" shaped depression. These two grooves are the mesio-lingual triangular groove and the mesial groove. On the distal aspect, the central groove divides similarly and forms the disto-lingual triangular groove and the distal groove. At the base of this "V" shaped depression, a ridge arises on both the mesial and distal surface. These ridges are known as the distal marginal ridge and the mesial marginal ridge. The buccal cusp presents a bucco-triangular ridge, and the lingual cusp presents a linguo-triangular ridge.

#### ROOT

The upper first bicuspid usually has two roots (Plate 8); these roots, however, are not bifurcate throughout their entire length; but even when the roots are united so that they resemble a single root there are practically always two pulp canals. The mesial and distal surfaces are flattened.

#### PULP CAVITY

The pulp cavity follows the general outline of the tooth (Plate 8), therefore, presenting two pulp canals, one in the buccal root and one in the lingual root.

**Lower First Bicuspid**

Plates 8, 12, 13, &amp; 14

The lower first bicuspid approximates with the lower cuspid on the mesial side and with lower second bicuspid on the distal side. The lower first bicuspid is the smallest of the bicuspid.

**CROWN PORTION**

The crown is bell-shaped and the occlusal surface at its major diameter is wider than the gingival. The crown is inclined lingually, which should be remembered when opening the pulp chamber for root canal work.

**BUCCAL SURFACE**

The buccal surface (Plate 12) is not so convex as in the upper first bicuspid.

**LINGUAL SURFACE**

The lingual surface (Plate 13) is smaller than the buccal and presents little area for mastication. It is also much straighter than the buccal surface. The lingual surface is divided by the lingual ridge.

**MESIAL AND DISTAL SURFACES**

The mesial and distal surfaces are convex (Plate 8). The buccal cusp and lingual cusp are divided by a "V" shaped depression.

**OCCLUSAL SURFACE**

Examination of the occlusal surface (Plate 14) shows that the buccal cusp is much larger than the lingual, on the lower first bicuspid. The two cusps are separated by the central fossa which runs mesio-distally. The mesial border is nearly straight, while the distal border is decidedly convex. The mesial and distal borders are surmounted respectively by the mesial marginal ridge and the distal marginal ridge. The



buccal cusp includes several triangular ridges while the lingual cusp carries the lingual ridge.

#### ROOT

The lower first bicuspid has only one root (Plate 8). The root is flattened on the mesial and distal surfaces. It tapers towards the apex and the apex may be curved distally.

#### PULP CAVITY

The pulp cavity follows the general outline of the root. Plate 8 shows the same arrangement of drawings of pulp cavities as explained previously. The drawings on this plate not only show the pulp cavities of the upper and lower first bicuspid, but also show the histological structure of these teeth. The histological structures shown are the enamel prisms, the dentinal tubules, the cementum and the pulp tissue.

#### PROBLEM

Make a copy of Plate 8 and label sections shown, as explained previously.

---

#### Upper Second Bicuspid

Plates 9, 12, 13, & 14

The upper second bicuspid approximates mesially with the upper first bicuspid and distally with the upper first molar. It resembles the upper first bicuspid, but is slightly smaller.

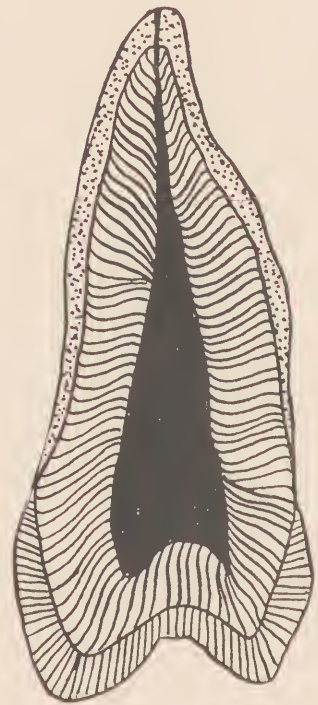
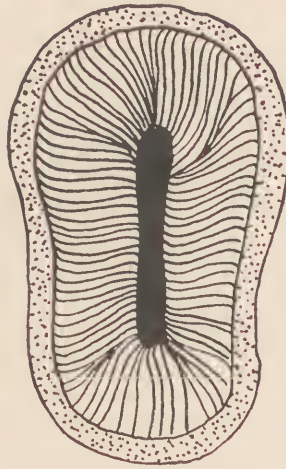
#### CROWN PORTION

The crown is not so bell-shaped as that of the upper first bicuspid, nor is there so great a constriction at the gingiva (Plate 9).

#### BUCCAL SURFACE

The buccal surface is similar to that of the upper first bicuspid. (Plate 12.)

## UPPER SECOND BICUSPID



## LOWER SECOND BICUSPID

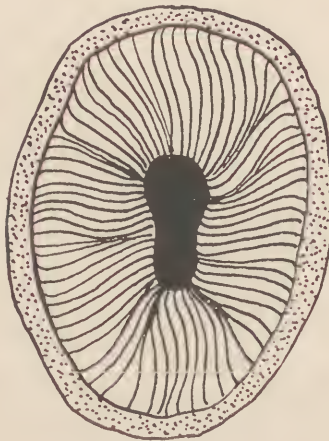


PLATE 9



**LINGUAL SURFACE**

The lingual surface has the same outline as that of the upper first bicuspid (Plate 13).

**MESIAL AND DISTAL SURFACES**

The mesial and distal surfaces are not so convex as the mesial and distal surface of the upper first bicuspid (Plate 9).

**OCCLUSAL SURFACE**

The occlusal surface is similar to that of the upper first bicuspid, except that the cusps and marginal ridges are not so well developed. The central fossa is shorter in length (Plate 14).

**ROOT**

This tooth has a single root and is slightly longer than the upper first bicuspid. There may be a curvature towards the distal at the apex of the root (Plate 9).

**PULP CAVITY**

The pulp cavity has the same outline as the tooth (Plate 9). In exceptional cases the pulp canal may be bifurcate.

---

**Lower Second Bicuspid**

Plates 9, 12, 13, & 14

The lower second bicuspid approximates mesially with the lower first bicuspid, and distally with the lower first molar.

**CROWN PORTION**

The crown is slightly longer than that of the lower first bicuspid. In general the characteristics are similar.

**BUCCAL SURFACE**

The buccal surface is convex. The buccal cusp is not so high as in the other bicuspid (Plate 12).

## LINGUAL SURFACE

The lingual surface is decidedly convex (Plate 13).

## MESIAL AND DISTAL SURFACES

The mesial and distal surfaces resemble those of the lower first bicuspid (Plate 9).

## OCCLUSAL SURFACE

The typical lower second bicuspid has a distinct buccal cusp and lingual cusp. The central fossa divides these cusps. This central fossa, or central groove, divides triangularly, to form several grooves mesially and distally. In the mesial area it forms the mesio-buccal triangular groove, and the mesio-lingual triangular groove. In the distal area, the disto-buccal groove and the disto-lingual groove, are similarly formed. The buccal cusp presents several triangular ridges, while the lingual cusp carries the lingual ridges. The mesial border of the mesio-buccal triangular groove and the mesio-lingual triangular groove, form the mesial marginal ridge. The distal border of the disto-buccal triangular groove and the disto-lingual triangular groove form the distal marginal ridge.

## ROOT

The root is larger than that of the lower first bicuspid (Plate 9).

## PULP CAVITY

The pulp cavity tapers towards the apex and resembles the general outline of the tooth.

The histological structures shown on Plate 9 are similar to those on Plate 8.

## PROBLEM

Make a copy of Plate 9 and label parts shown.

## Upper First Molar

Plates 10, 12, 13, &amp; 14

The upper first molar approximates mesially with the upper second bicuspid and distally with the upper second molar. It is the largest of the upper molars. It may be distinguished from the other molars by its fifth cusp (rudimentary), on the lingual surface, when present. This fifth cusp may be absent as in Plate 13; it may be little more than a tubercle of enamel, or it may be quite pronounced. However, it is never as high as the other cusps.

## CROWN PORTION

The crown (Plate 10) is rhomboidal in form and is bounded by the following surfaces: occlusal, buccal, lingual, mesial and distal. The crowns of the molars in general are smaller at the gingiva than at the occlusal.

## BUCCAL SURFACE

The buccal surface (Plate 12) is rectangular in shape and generally convex. Near the occlusal surface it divides, presenting two cusps, the mesio-buccal and disto-buccal cusps. These cusps are separated by the buccal groove, which has its origin in the central groove.

## LINGUAL SURFACE

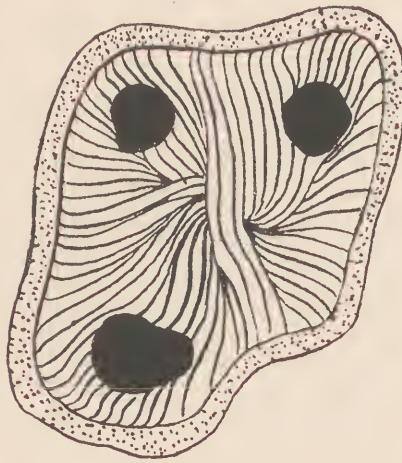
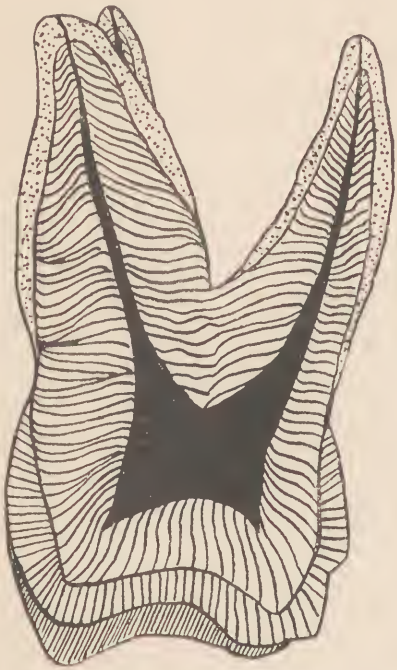
The lingual surface (Plate 13) is not so rectangular in shape as the buccal surface, due to the conversion of the mesial and distal borders. The lingual groove divides the surface near the occlusal area into two cusps; the disto-lingual cusp and the mesio-lingual cusp. There may be another cusp on this surface, situated near the mesio-occlusal border. This is the fifth cusp.

## MESIAL SURFACE

The mesial surface is convex at the occlusal area while the gingival portion is either straight or concaved.



## UPPER FIRST MOLAR



## LOWER FIRST MOLAR

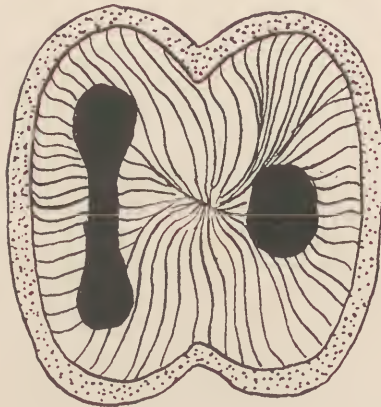


PLATE 10

### DISTAL SURFACE

The distal surface in general resembles the mesial but is more convex.

### OCCLUSAL SURFACE

The occlusal surface (Plate 14) is rhomboidal in form, presenting four cusps, the mesio-buccal, disto-buccal, mesio-lingual and disto-lingual cusps. The mesio-lingual cusp is the largest of the four, while the disto-lingual cusp is the smallest. The occlusal surface also presents triangular ridges, a central groove which divides to form the mesial, buccal and distal grooves, and a disto-lingual groove which divides into distal and lingual grooves.

### ROOTS

The roots of the upper first molar (Plates 12 and 13) are the mesio-buccal, disto-buccal and lingual roots. The lingual root is the largest. The apices of the buccal roots converge towards each other.

### PULP CAVITY

The pulp cavity (Plate 10) follows the general outline of the tooth. From the pulp chamber, three canals lead into the three roots.

Plate 10 shows the distal and lingual roots, the cross-section and the mesial and distal roots. The shading representing the histological structures has been explained before.

---

### Lower First Molar

Plates 10, 12, 13, & 14

The lower first molar approximates mesially with the lower second bicuspid, and distally with the lower second molar. It is the largest of the lower molars. It is inclined lingually, which should be remembered when seeking access for entrance into the pulp chamber of this tooth. Normally it has five cusps.

## CROWN PORTION

The crown is irregularly cuboidal and presents five surfaces for examination.

## BUCCAL SURFACE

The buccal surface (Plate 12) is trapezoidal in form and differs from the buccal surface of the upper molars in that it is longer mesio-distally and presents three cusps on this surface instead of two. The cusps are the mesio-buccal, disto-buccal and distal. These cusps are formed by the buccal and disto-buccal grooves.

## LINGUAL SURFACE

The lingual surface (Plate 13) resembles the lingual surface of the upper first molar, and shows two cusps, the mesio-buccal and the mesio-lingual.

## MESIAL SURFACE

The mesial surface is generally convex; the mesial groove passes over this surface.

## DISTAL SURFACE

The distal surface is convex at the occlusal area and may be concave at the gingival. This surface is crossed by the disto-buccal and disto-lingual triangular grooves.

## OCCLUSAL SURFACE

The occlusal surface is trapezoidal in form (Plate 14). The buccal-occlusal surface is marked by three cusps while the lingual-occlusal surface is marked by two cusps. The mesio-buccal cusp is the largest and the disto-lingual cusp the smallest. The central fossa divides the buccal cusps and lingual cusps. The central groove sends two grooves over the buccal-occlusal surface. These two grooves are the



mesio-buccal and disto-buccal grooves. These grooves form the three cusps on the buccal side. The lingual groove forms the two cusps on the lingual side. The central groove terminates on the distal surface as the distal groove, while on the mesial it separates to form two grooves, the mesio-buccal triangular groove and the mesio-lingual triangular groove. These grooves form the mesial marginal ridge. The surface also presents occlusal and triangular ridges.

#### ROOTS

The lower first molar has two roots (Plate 10), the mesial root and distal root. These roots are inclined distally. They are more or less flattened on the mesial and distal surfaces; these surfaces may also be grooved.

#### PULP CAVITY

There are three canals in the lower first molar (Plate 10); two in the mesial root and one in the distal root. In exceptional cases the distal root canal may be bifurcate. The coronal portion of the pulp cavity follows the same outline as the tooth.

The sections of the lower first molar shown on Plate 10 are as follows:—Bucco-lingual section of the mesial root, a cross-section, and the bucco-lingual section of the distal root.

#### PROBLEM

Make a copy of Plate 10 and label sections shown.

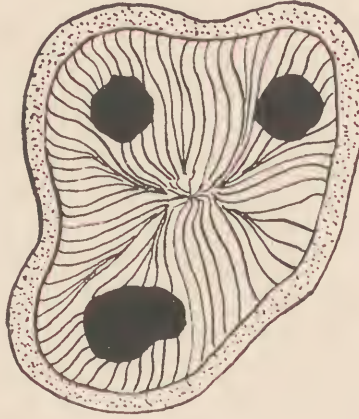
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#### Upper Second Molar

Plates 11, 12, 13, & 14

The upper second molar approximates mesially with the upper first molar, and distally with the upper third molar.

## UPPER SECOND MOLAR



## LOWER SECOND MOLAR

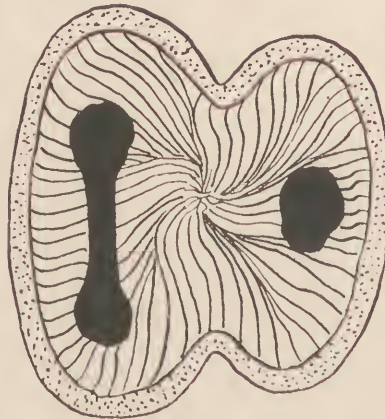
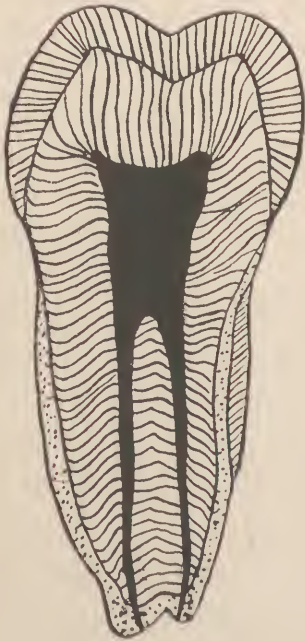


PLATE II

### CROWN PORTION

The crown (Plate 11) is slightly smaller than the upper first molar. This crown does not have a fifth cusp, but otherwise resembles the upper first molar.

### BUCCAL SURFACE

The buccal surface (Plate 12) resembles the buccal surface of the upper first molar, although the buccal groove is not so well developed, and the surface in general is less convex.

### LINGUAL SURFACE

The lingual surface (Plate 13) resembles the lingual surface of the upper first molar.

### MESIAL AND DISTAL SURFACES

The mesial and distal surfaces of the upper second molar present the same features as the mesial and distal surfaces of the upper first molar.

### OCCLUSAL SURFACE

The occlusal surface (Plate 14) presents the same ridges and grooves as the upper first molar; however, the triangular ridges, the central groove and the disto-lingual cusp are not so well developed. If the disto-lingual cusp be very small, or absent, the occlusal surface will be triangular in form.

### ROOTS

The roots (Plate 11) present are the same in number as in the upper first molar; however, the roots of the upper second molar have a tendency to converge together.

### PULP CAVITY

Follows the general outline of the tooth (Plate 11).



**Lower Second Molar**

Plates 11, 12, 13, &amp; 14

The lower second molar approximates mesially with the lower first molar and distally with the lower third molar.

**CROWN PORTION**

The crown (Plate 11) resembles that of the first lower molar, but is smaller in size and has but four cusps.

**BUCCAL SURFACE**

The two cusps on the buccal surface are separated by the buccal groove (Plate 12). The surface is generally convex with gingival border straight.

**LINGUAL SURFACE**

The lingual surface (Plate 13) is convex and in general resembles the lingual surface of the lower first molar.

**MESIAL AND DISTAL SURFACES**

The mesial surface is slightly more convex than the mesial surface of the lower first molar; otherwise the mesial and distal surfaces resemble those of the lower first molar.

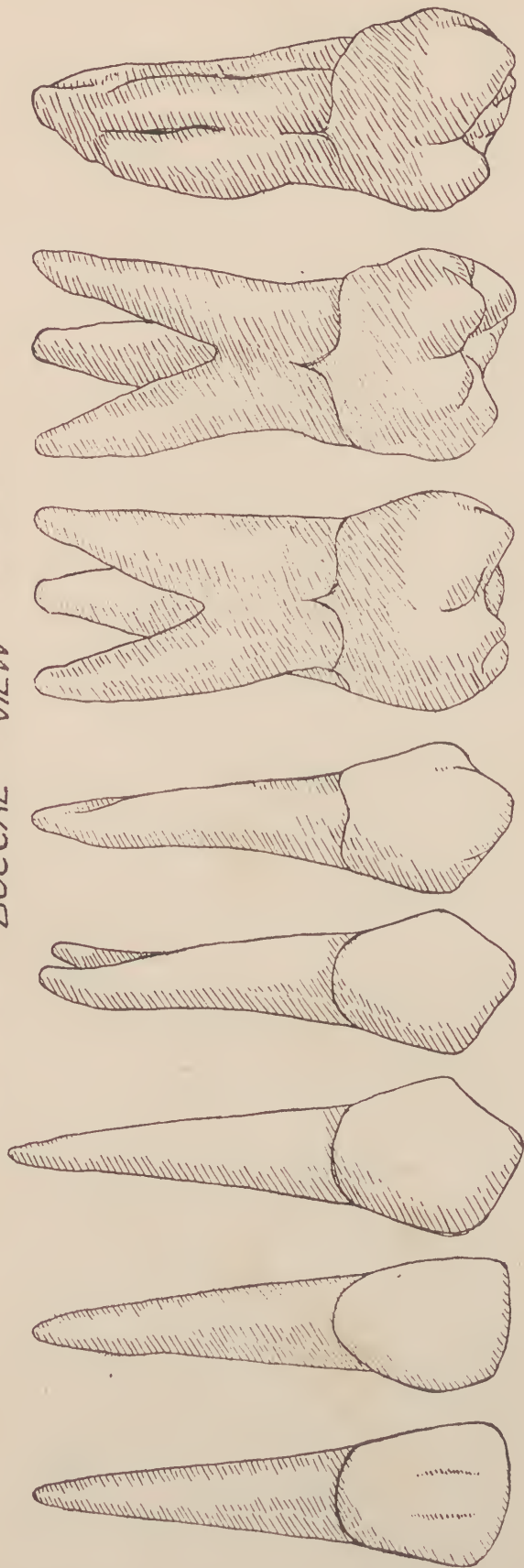
**OCCLUSAL SURFACE**

The occlusal surface (Plate 14) is rectangular in form, presenting four cusps for examination: the mesio-buccal, disto-buccal, mesio-lingual and disto-lingual cusps. These cusps are formed by the central groove, buccal groove and lingual groove. The central groove is deeper and better developed in the lower second molar. The triangular ridges are sharper.

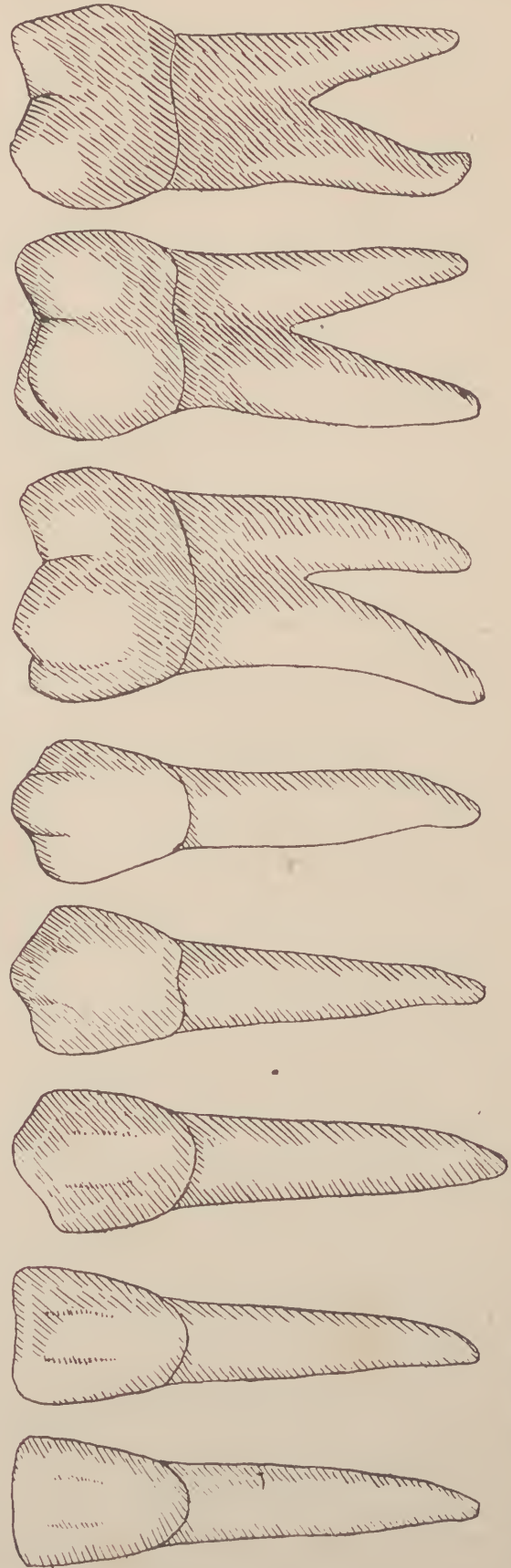
**ROOTS**

The roots are similar to those of the lower first molar but have a marked distal inclination and are generally close together (Plate 11).

**UPPER PERMANENT TEETH**  
BUCCAL VIEW

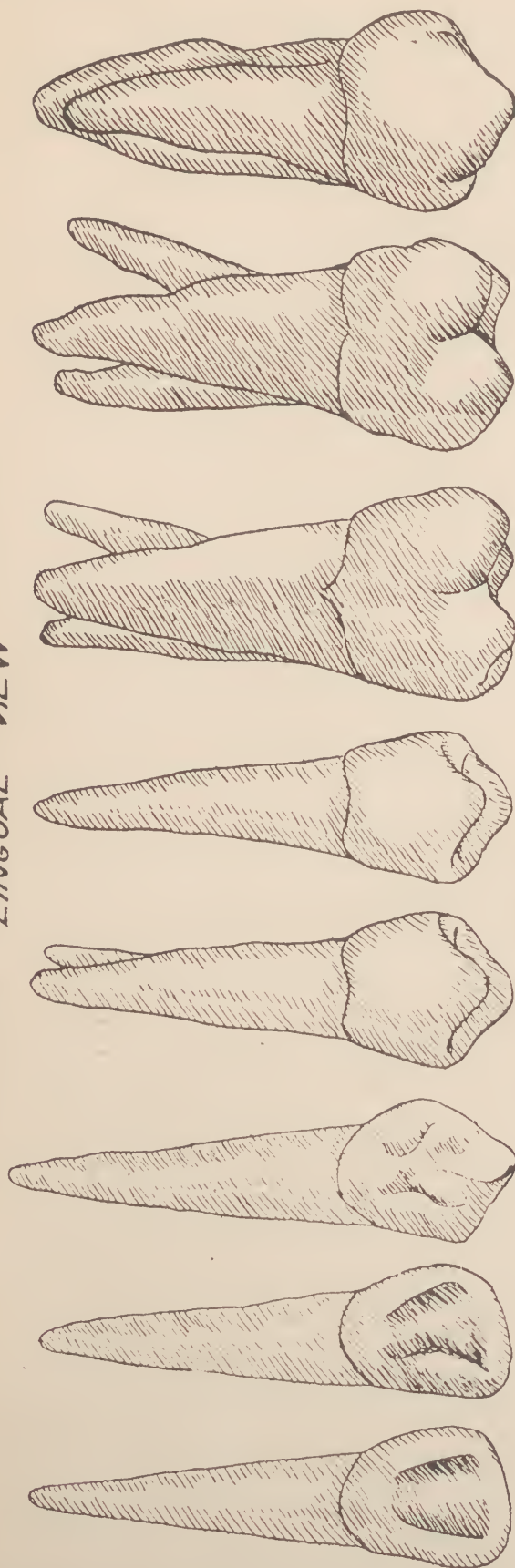


**LOWER PERMANENT TEETH**  
BUCCAL VIEW

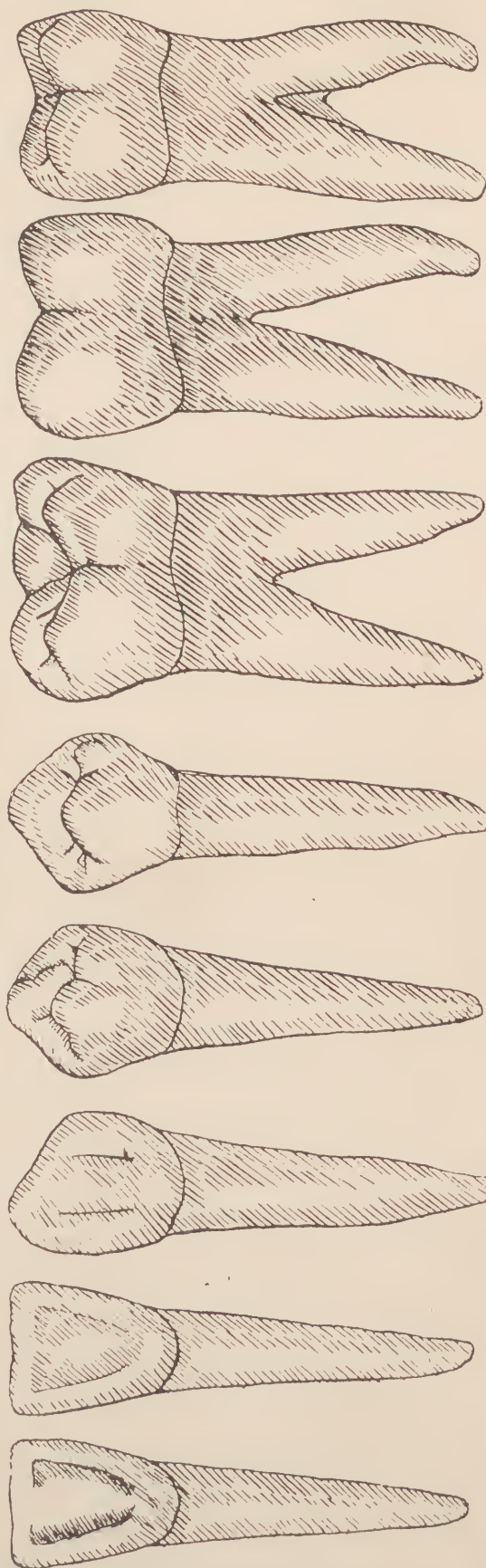


**PLATE 12**

**UPPER PERMANENT TEETH**  
LINGUAL VIEW



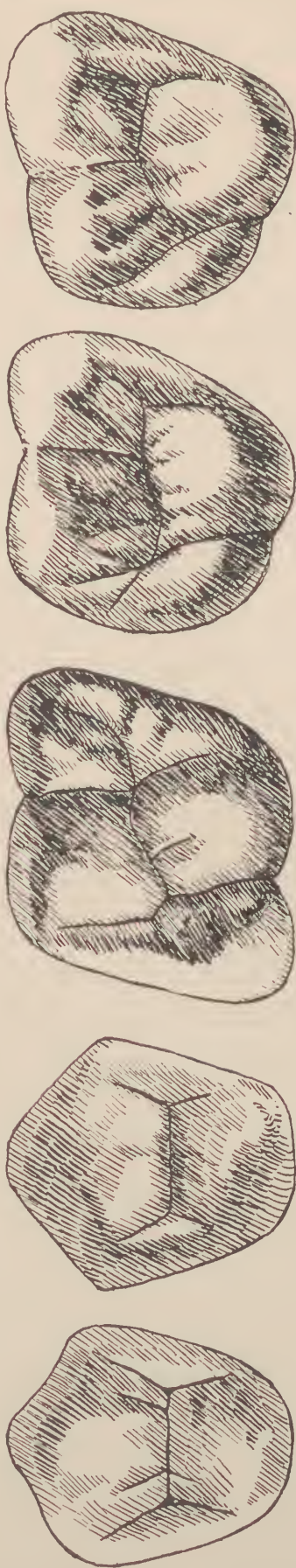
**LOWER PERMANENT TEETH**  
LINGUAL VIEW



**PLATE 13**



**UPPER PERMANENT TEETH**  
*OCCLUSAL SURFACE*  
*BICUSPIDS AND MOLARS*



**LOWER PERMANENT TEETH**  
*OCCLUSAL SURFACE*  
*BICUSPIDS AND MOLARS*



**PLATE 14**

## PULP CAVITY

The pulp cavity (Plate 11) follows the general outline of the tooth. The division of the canals in the mesial root may or may not exist.

## PROBLEM

Draw Plate 11 as it appears, using same type of lettering and shading.

---

Upper Third Molar

Plates 12, 13, & 14

The upper third molar approximates mesially with the upper second molar. It is the smallest of the molar series. The tooth varies in form considerably, but when typical it should resemble the upper second molar. The disto-lingual cusp is entirely absent, and the occlusal surface is triangular. The roots are generally fused together, being separated only by grooves. The number of roots vary in this tooth; there may only be a single root, or there may be five or six roots. The pulp cavity varies accordingly.

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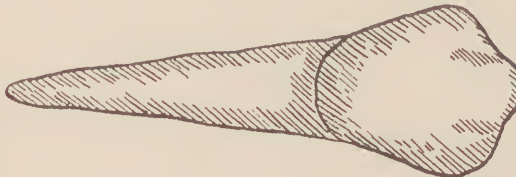
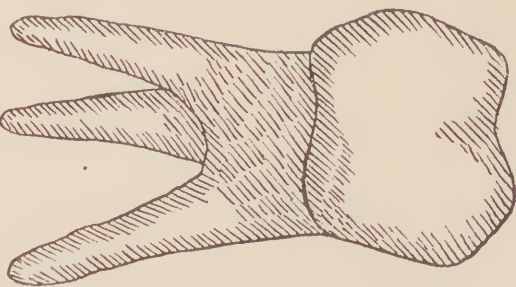
Lower Third Molar

Plates 12, 13, & 14

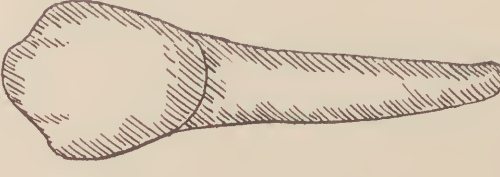
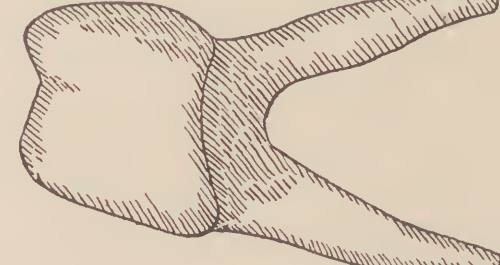
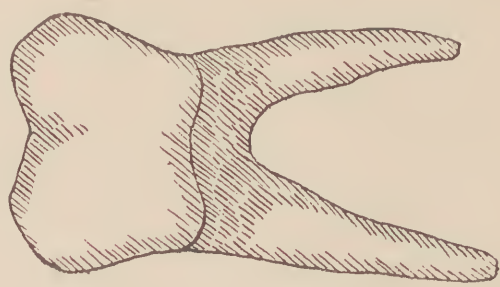
The lower third molar approximates mesially with the lower second molar. Like the upper third molar it also varies in size, shape and form. The occlusal surface may present four or five cusps; however, the four cusp tooth is typical. If it be a four-cusp tooth, the occlusal surface will resemble the lower second molar, with the addition of a number of grooves that radiate from the central fossa. The roots resemble those of the lower second molar. They may, however, be fused, showing only a slight distinction between the mesial and distal root. The roots may be curved distally. The pulp cavity follows the general outline of the tooth. This tooth may sometimes never erupt, due to the fact that it is impacted.



**UPPER DECIDUOUS TEETH**  
*BUCCAL VIEW*



**LOWER DECIDUOUS TEETH**  
*BUCCAL VIEW*



### Buccal Surfaces of Permanent Teeth

#### Plate 12

The buccal and labial surfaces of all the teeth are shown on Plate 12. These surfaces have been discussed separately under the anatomical description of each tooth. Draw Plate 12, using the shading shown to bring out detail and outline form of the teeth in general.

---

### Lingual Surfaces of Permanent Teeth

#### Plate 13

The lingual surfaces of all the teeth are shown on Plate 13. These surfaces have also been discussed separately under the anatomical description of each tooth. Draw Plate 13, using shading and lettering as it appears on your copy.

---

### Occlusal Surfaces of Permanent Teeth

#### Plate 14

Plate 14 shows the occlusal surfaces of the bicuspid and molars. The occlusal surfaces have been discussed previously. In drawing Plate 14, note the contour of the cusps, the grooves and the general outline, so that you may be able to reproduce them in your crown and bridgework and in general operative dentistry.

---

### Deciduous Teeth

#### Plate 15

The deciduous teeth are shown on Plate 15. These are the "baby" teeth that serve for mastication until the jaw-bones are sufficiently developed to accommodate the permanent teeth. The roots of these teeth are absorbed

through a physiological process, preceding the eruption of the permanent teeth. When absorption is complete, the crowns become loosened and the teeth are shed.

There are twenty deciduous teeth; two central incisors, two lateral incisors, two cuspids, two first molars and two second molars, in each jaw. The teeth are smaller than those of the permanent set but generally resemble their successors with the exception of the first deciduous molars. The reduction in size is symmetrical and includes the whole tooth, except that the roots are proportionately longer. A distinguishing feature, which differentiates the deciduous teeth from the permanent, is the marked constriction at the necks of the deciduous teeth. The enamel terminates abruptly and retains its thickness at the gingiva, instead of thinning down, as in the permanent teeth.

The roots of the deciduous teeth are the same in number as in the similar permanent teeth. The roots of the deciduous molars, however, are more divergent. This divergence allows the crown of the bicuspid to fit in between them. The deciduous roots in the lower jaw are thin mesio-distally. The bucco-lingual surface of these roots are broad and may be grooved. The deciduous roots of the upper molars are also widely divergent; the lingual root is inclined extremely towards the lingual. The lower deciduous molars appear very long mesio-distally. This is due to the occlusal inclination of the buccal and lingual surfaces, which causes the occlusal surface to present a smaller masticating area. The cusps of the deciduous teeth are sharper and the sulci deeper as a general rule. The enamel of the deciduous teeth appears whiter and is of a coarser texture than that of the permanent teeth.

#### PROBLEM

Draw and shade Plate 15 as shown on copy.



SECTIONAL DRAWING  
OF  
LOWER FIRST MOLAR AND ALVEOLUS

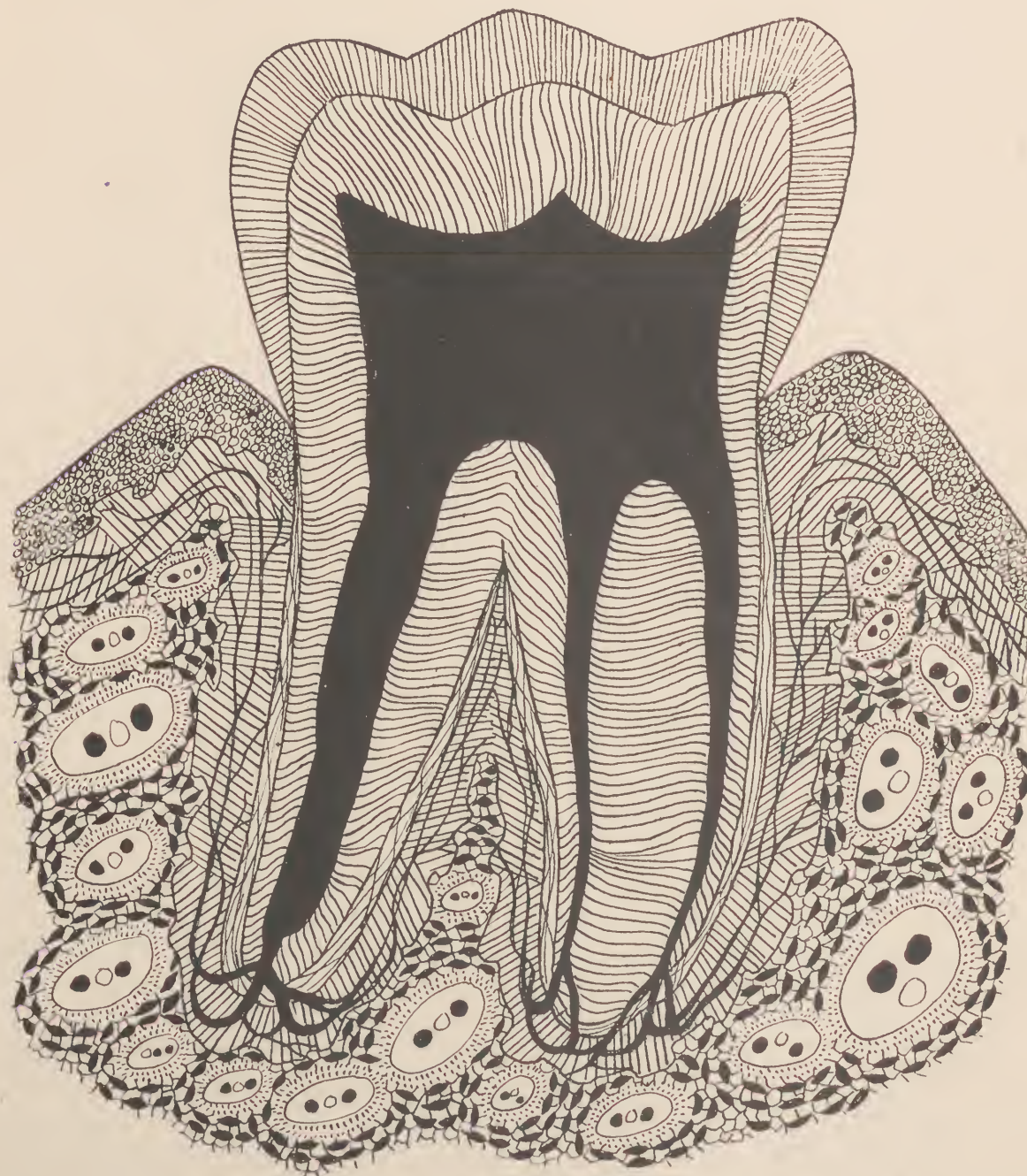


PLATE 16



## Lower First Molar and Alveolus

## Plate 16

Plate 16 shows the lower first molar and the histological structure of this tooth. The crown portion and roots are shown. The enamel rods, which have been described before, are illustrated by lines running in directions characteristic of the enamel. The wavy curvature of the dentinal tubules is shown. The cementum, which is arranged in consecutive layers around the tooth, is also indicated. This plate shows the pulp cavity with the two canals in the mesial root and the one canal in the distal. The canals in previous drawings have been illustrated as terminating singularly at the apex. This is very rare in the bicuspid and molars, because most canals divide near the apex to form numerous foramina. Through these openings the blood vessels, nerves, and lymphatics pass. The peridental membrane is illustrated by line shading, which represents groups of fibers in this tissue. This tissue lies between the root and the alveolus. It acts as a cushion for the tooth. The cellular gum tissue is illustrated by a series of small circles. The alveolar process with the lacunæ and canaliculi is also shown.

## PROBLEM

In drawing Plate 16 be very careful to shade it as illustrated, for most of the shading is characteristic of the tissue which it represents.

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The Mandible—Lower Jaw-Bone

## Plate 17

The mandible is horseshoe shaped and is composed of a body and two rami. The rami are the portions that arise posteriorly from the body. In the region of the bicuspid you will note, on each side, a circular shaded portion; these are the mental foramina, one on each side. The prominent pro-

# THE MANDIBLE

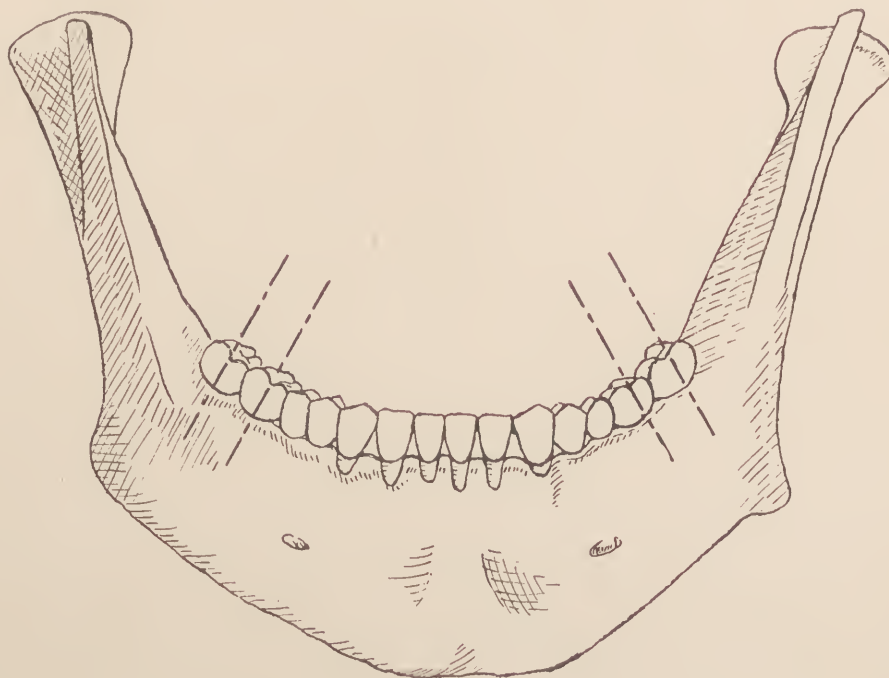
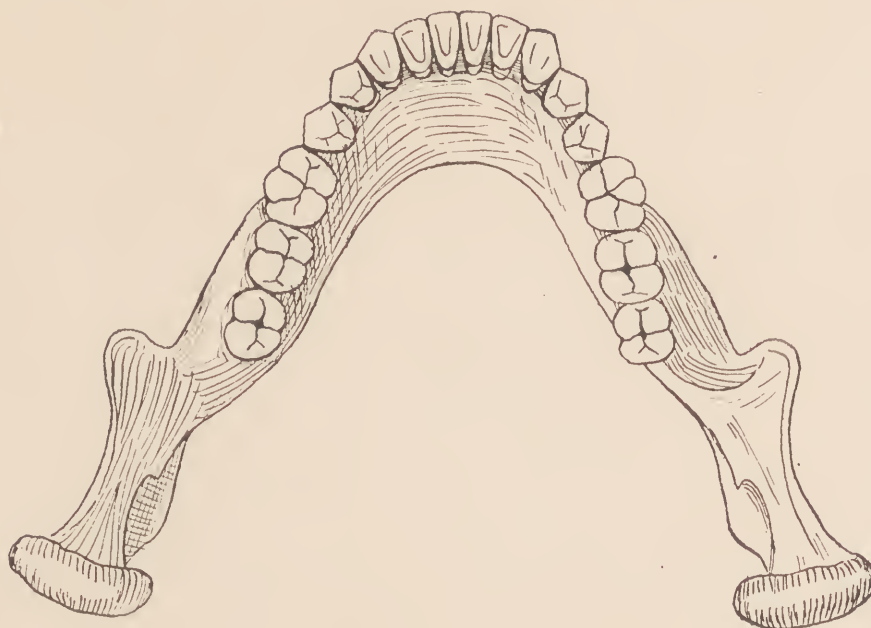


PLATE 17

**OCCUSION OF TEETH**  
**SIDE VIEW**

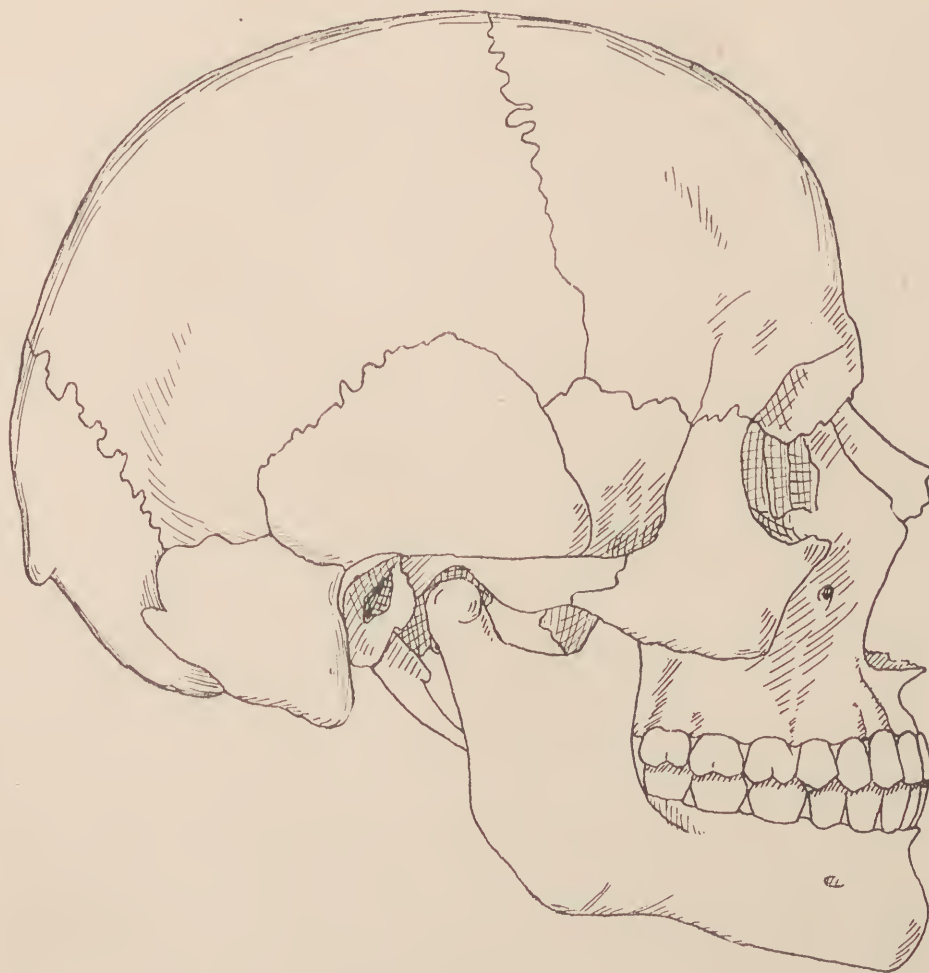


PLATE 18

**OCCCLUSION OF TEETH**  
**FRONT VIEW**

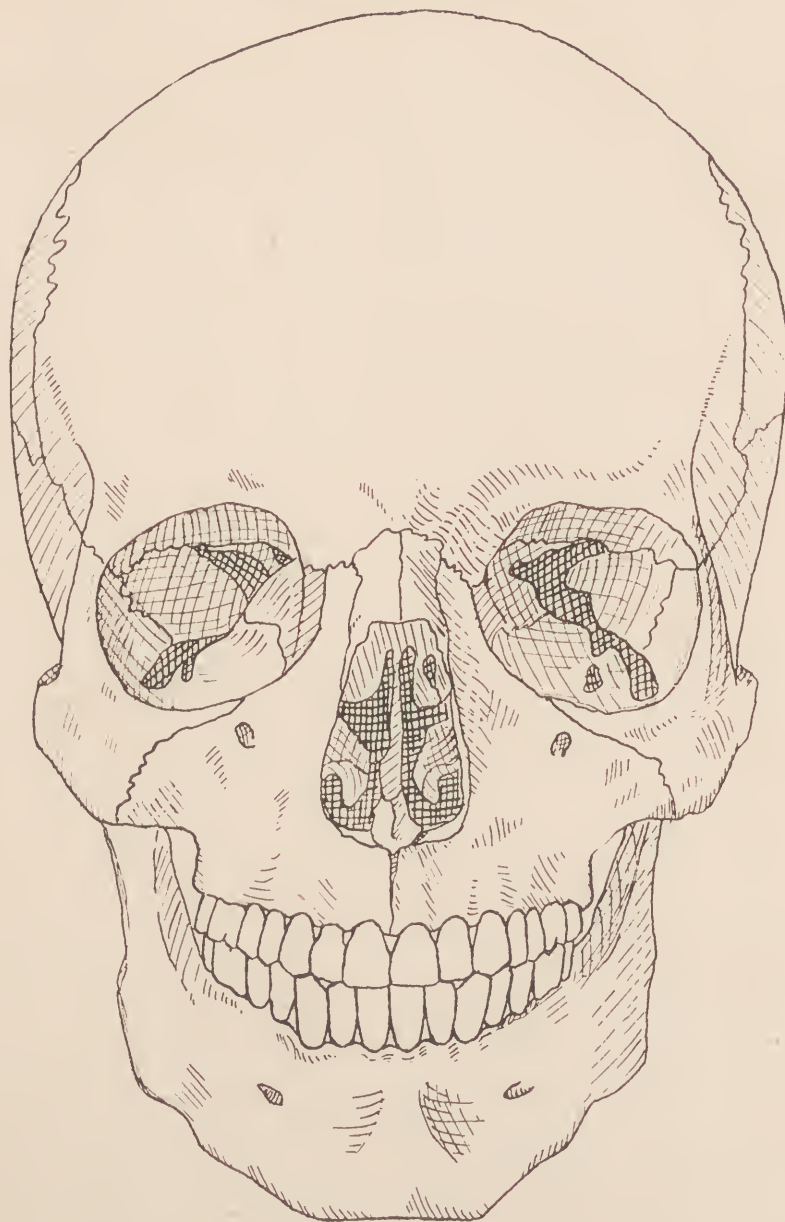


PLATE 19

tubercle connecting the two halves of the body is the symphysis menti. Besides illustrating the mandible, this plate shows that the lower molars and bicuspid are not seated straight in the sockets of the mandible but are tipped lingually. This is very important and a realization of this fact will aid you in the opening and cleansing of the pulp cavity for root canal work in these teeth.

#### PROBLEM

Draw Plate 17, and in the lower drawing of the mandible on this plate, starting at the termination of the dotted lines that pass upward through the molars have this lettering centered in the space allowed for it:—"Showing Lingual Inclination of Molars."

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### Occlusion of Permanent Teeth

#### Plates 18-19

Plates 18 and 19 show the occlusion of teeth, front and side views. It will be seen from these plates, that each tooth occludes with two teeth of the opposing jaw, with the exception of the upper third molar and lower central. Angle's key to normal occlusion is as follows: The mesio-buccal cusp of the upper first molar occludes in a normal occlusion, with the buccal groove of the lower first molar. The upper teeth slightly over-lap the lower teeth.

#### PROBLEM

Draw Plates 18 and 19 and shade parts as represented on your copy.



## X

### THE EVOLUTION OF THE FACE

Plates 20, 21, & 22

THE purpose of Plates 20, 21, and 22 is to show you the development of the human face and the changes which it undergoes as old age approaches. In the discussion of these plates, we will limit ourself to the anatomy of the mouth.

The mouth is a projection from the mold of the head. A clean cut mouth has considerable sharpness all along the edges of both lips. The sharp edge, however, in most mouths is usually formed along the front plane of the lower lip and the outer edges of the upper lip. The red surface of the mouth determines the thickness of the lips. The lips are thickest in their front plane and taper towards the outer corners. The lips form a convex rim. This convexity is due to bony structure of the jaw-bones and arches of teeth, over which the mouth fits tightly. The lower jaw is held in its position, or in other words held from sliding forward, by the teeth in occlusion. In senility (Plate 22) when the teeth are lost, the lower jaw slides forward and seems to push the whole front part of the face together. The loose flesh of the lips continues to hang to the bone, resulting in the falling inwards of both lips and the formation of heavy lines at the corners of the mouth. This protruding jaw extends farther forward than the upper lip. The reverse is true of a child's profile (Plate 20); here the fullness of the child's cheek forces the upper lip to protrude and the chin to recede.

# EVOLUTION OF THE FACE

## *INFANCY*



PLATE 20

EVOLUTION OF THE FACE  
*MATURITY*



PLATE 21

EVOLUTION OF THE FACE  
*SENILITY*



PLATE 22

## PROBLEM

It will be necessary for you to square off the copy and your drawing with  $\frac{1}{2}$ -inch squares, so that you may sketch in the outline of the faces with some exactness and likeness of copy. Simply mark off on the horizontal and vertical border lines  $\frac{1}{2}$ -inch spaces. With your T square and pencil rule these lines. Having determined the distance the outline of the face is to be from the border line, sketch in the drawing by noting where the lines cross the squares on the copy. Do this for Plates 20, 21, and 22. These guide lines and squares may be erased after you ink in.











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